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ABSTRACT

An instructor's manual and student activity guide on the machine shop are provided in this set of prevocational education materials which focuses on the vocational area of trade and industry. (This set of materials is one of ninety-two prevocational education sets arranged around a cluster of seven vocational offerings: agriculture, home economics, distributive education, health occupations, world of work, trade and industry, and office occupations.) The instructor's guide is organized into the following elements: title of activity, duration of activity (thirteen to fourteen days), activity goals, twenty-two instructional objectives, related vocational clusters, and activity implementation (description, safety precautions, materials needed, teacher preparation prior to class, during the class, follow-up activities, and masters for duplication). The student activity guide provides step-by-step instructions (narrative and illustrations) for completing each instructional objective. At the end of each set of instructions is a student check point (evaluation activity and answer key). Occupational descriptions for a machinist, maintenance machinist, tool-machine set-up operator, and production-machine tender conclude the document. (JH)

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ED169372

T & I — MACHINE SHOP

Kit No. 83

INSTRUCTOR'S MANUAL

Prepared by

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1978

U.S. DEPARTMENT OF HEALTH
EDUCATION & WELFARE
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Department of Health, Education and Welfare, Office of Education.*

TITLE OF ACTIVITY

Kit No. 83, T & I — Machine Shop

DURATION

Main Activity: 12 days

Follow-up Activity: 1 — 2 days

GOALS

Each student will be introduced to a variety of hand tools and their application. Students will gain self-confidence and pride in their work through this activity.

INSTRUCTIONAL OBJECTIVES

Using a metal rule, the student will be able to measure lengths and read dimensions.

The student will be able to identify and use the four basic layout tools.

The student will become familiar with the parts of and the proper use of a hacksaw.

The student will identify the parts of a file and proper use of the file.

The student will identify the parts of a vise and will learn how to use the vise.

The student will identify the parts of a 3/8 inch hand power drill, learn how to use the drill correctly, and the safety rules which are observed when using a drill.

The student will identify the parts of a table-mounted drill press and learn how to use it correctly.

The student will identify the parts of and use a tap.

Given proper tools and equipment, the student will measure and cut stock.

Given the proper tools and equipment, each student will locate the position of holes to be drilled in the metal used in objective 9.

The student will drill eight 1/4 inch (.64 cm) holes in both pieces of metal.

The student will measure and cut stock for center block of the puller.

Using layout tools, each student will measure and mark the holes located in the center block of metal.

Each student will drill two 1/4 inch (.64

cm) holes in these center blocks of metal.

Using the center block (3/4 x 3/4 x 1-5/8 inch) of metal, each student will drill and tap a 3/8 UNF hole through the center of the metal block.

Given the proper tools, each student will measure and cut two pieces of 1/4 x 3/4 inch flat stock. These will be used for the hooks of the gear puller.

The student will measure, mark and drill 1/4 inch holes in each hook of the gear puller.

Using the proper tools, each student will lay out the hook shape for the gear puller. (Refer to the working drawing handout.)

Given the correct tools, the student will form and file the hooks.

Given all tools and equipment, each student will cut and file four 3/4 x 1/4 inch spacer blocks.

Using the proper tools and equipment, each student will drill a 1/4 inch hole in all spacers.

The student will assemble (put together) the gear puller.

VOCATIONAL CLUSTERS

Trade and Industry, Health, Agriculture

ACTIVITY IMPLEMENTATION

A. Description

First Day: Each student will read the material concerning measuring, layout, hacksaw, filing, vise, hand drill, and complete the checkpoint at the end of each objective.

Second Day: Each student will read the material concerning the use of a drill stand and tap and complete the checkpoints at the end of each objective.

Third Day — Twelfth Day: Each student or group of students will cut, file, drill and assemble a gear puller.

B. Safety

Caution should be observed when using the sharp-pointed scribe.

Check the handle on the file for a tight fit.

Clamp the vise securely to work bench (or table).

Always clamp metal tightly in the vise before sawing, filing, drilling, or tapping threads.

Wear safety glasses at all times when drilling holes.

Check the condition of the cord on the electric drill.

Remove the chuck key from the drill before operating drill motor.

Always unplug the drill when changing the drill bit.

C. Materials Required

1. Audio Visual Equipment:

None

2. Technical Equipment:

25 metal rules, 18 inch (45.7 cm)
5 squares, 6 inch (15.24 cm)
5 scribes
5 prick punches
5 hacksaws
5 single-cut smooth files and handles, 8 inch
5 vise jaws, 3 inch
5 ball peen hammers, 8 ounce (.23 kg)
3 electric drills, 3/8 inch
3 drill stands
10 safety glasses
5 taps, 3/8 inch — 24
5 tap handles

3. Expendable Supplies:

625 inches of 1/4 x 3/4 inch flat stock
50 inches of 3/4 x 3/4 inch square stock
100 inches of 1/4-20 x 2 inch bolts and nuts
25 inches of 3/8-24 x 5 inch bolt threaded all the way up the entire shaft
10 drill bits, 1/4 inch and 1/8 inch
5 hacksaw blades

D. Preparation Prior to Class

Order: 625 inches of 1/4 x 3/4 inch flat stock cold rolled
50 inches of 3/4 x 3/4 inch square stock cold rolled

1 box of 100 1/4-20 x 2 inch bolts

1 box of 100 1/4-20 nuts

30 bolts threaded all the way up, 3/8-24 x 5 inches

Duplicate student answer sheets, one for each student

Read Student Activity Guide and be aware of areas where safety rules are applied.

E. During Class Session

Students should be aware that no one is to do an objective or step out of sequence. Ask the student to turn to page one of the programmed text for Machine Shop. Read the instructional objectives, goals, and directions; then let each student begin the programmed text.

Instruct students to read each step carefully. Check to see that each checkpoint is completed and correct. Allow students to work at a steady pace, not too fast, nor too slow. See that safety rules are followed and that the correct use of each tool is observed.

F. Follow-up Activity

1. Have students fill in VIEW Fact Sheet.
2. Identify in newspapers job openings as a machinist or metal worker.

MASTERS FOR DUPLICATION

1. VIEW Fact Sheet
2. Final drawing of project
3. Student Answer Sheet

VIEW FACT SHEET

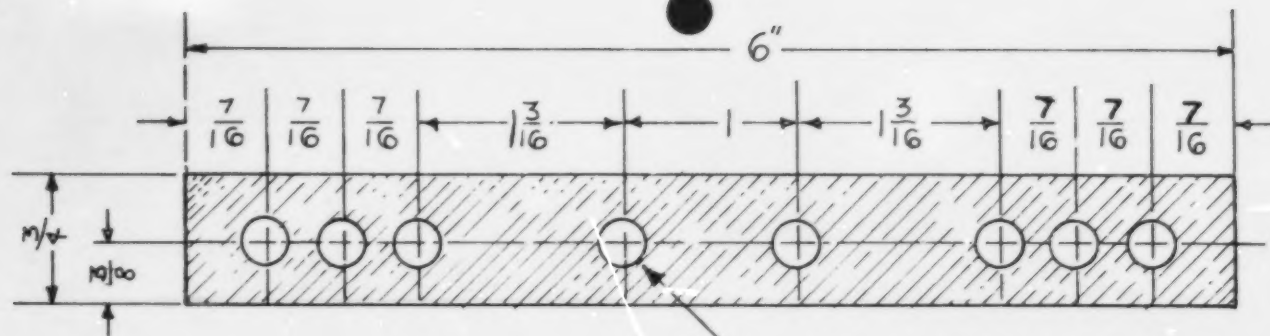
NAME _____ CLASS _____ OCCUPATION _____

- A. List the advantages (good points) of this occupation (job).
- B. List the disadvantages (bad points) of this occupation (job).
- C. List three things you should know to do this occupation (job).
 - 1.
 - 2.
 - 3.
- D. What type of education should you get to be prepared (do) for this occupation (job)?
- E. What courses must you take to go into this occupation (job)?
- F. What do you think your future in this occupation (job) will be?
- G. What wage can you expect in this occupation (job)?
- H. What are the working hours of this occupation (job)?
- I. To learn more about this occupation (job), write to:
- J. Using a scale of 1 to 5, circle the number that measures your interest in this occupation (job) as a possible career.

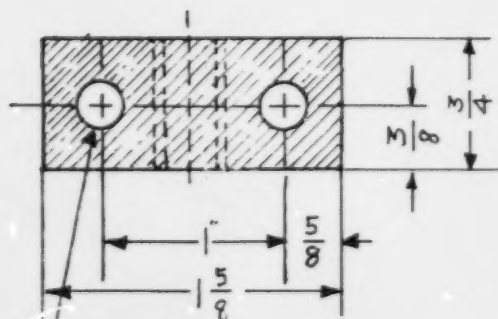
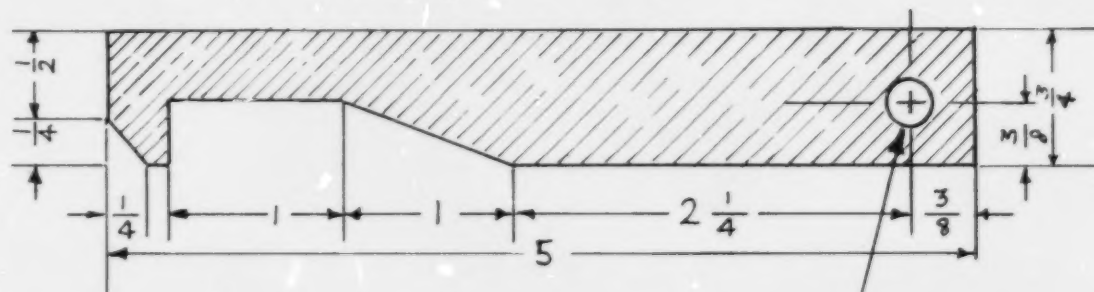
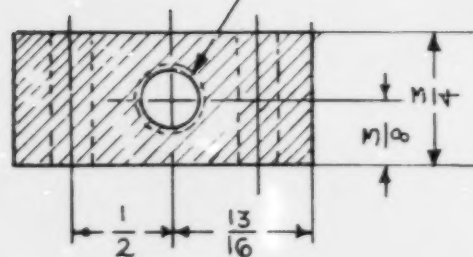
I don't like it. ← 1 2 3 4 5 → I like it.

3

C



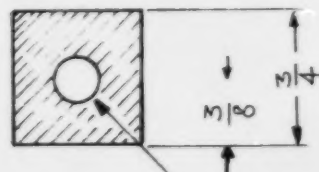
$\frac{3}{8}$ UNF, USE $\frac{21}{64}$ OR 9 (DRILL)



$\frac{1}{4}$ DIA.

$\frac{1}{4} \times \frac{3}{4}$ ROLLED STEEL

1 REQ. (CENTER BLOCK)



$\frac{1}{4}$ DIA.

$\frac{1}{4} \times \frac{3}{4}$ ROLLED STEEL

4 REQ. (SPACER)

$\frac{1}{4}$ DIA.

$\frac{1}{4} \times \frac{3}{4}$ ROLLED STEEL

2 REQ (HOOK)

STUDENT ANSWER SHEET

Objective I

1. _____
2. _____
3. _____
4. _____
5. _____

Objective II

1. _____
2. _____
3. _____
4. _____
5. _____

Objective III

1. _____
2. _____
3. _____
4. _____

Objective IV

1. _____
2. _____
3. _____
4. _____
5. _____

Objective V

1. _____
2. _____
3. _____

Objective VI

1. _____
2. _____
3. _____
4. _____
5. _____
6. _____

Objective VII

1. _____
2. _____
3. _____
4. _____
5. _____

Objective VIII

1. _____
2. _____
3. _____
4. _____

T & I – MACHINE SHOP

Kit No. 83

**STUDENT
LEARNING ACTIVITY GUIDE**

Prepared by

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MAKING A GEAR PULLER

INTRODUCTION

In this programmed text the student will be instructed in basic layout principles, using a hacksaw, file, vise, and hand drill.

Being able to measure accurately is essential in doing metal work. A person working with metal must be able to measure lengths, read dimensions, and figure materials.

GOALS

The student will learn to measure with a metal rule.

The student will learn the parts of and use the hacksaw.

The student will learn the parts of and the use of a file.

The student will learn the parts of and how to use a vise.

The student will learn the parts of and how to use an electric hand drill.

The student will learn all safety rules needed to operate this equipment.

The student will learn to use a table mounted drill press.

The student will perform self test at the end of each section.

The student will make an adjustable gear puller.

DIRECTIONS

To use the programmed self-instructional method of teaching, the student will begin with the programmed text. The programmed text is a step-by-step process. In each section there will be an Instructional Objective which will explain briefly what the student is to do. The sequenced instruction is a step-by-step explanation of what is being done; it will be accompanied by a picture of each activity or a picture of the tool being explained in the sequenced directions.

Each section of the sequenced instruction will be followed by a Checkpoint. The Checkpoint will have a practice sheet with a short quiz on what was just covered.

Be sure to follow this programmed text in correct order.

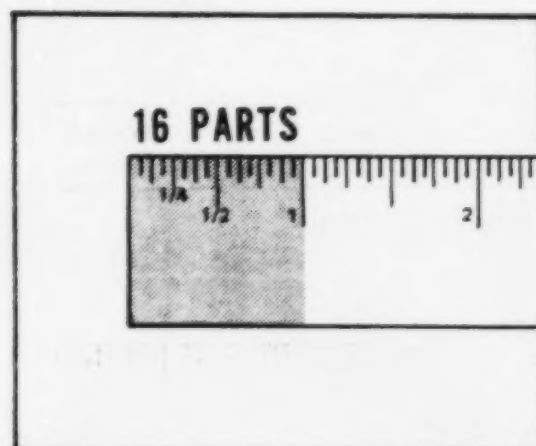
MATERIALS

All metal and tools will be obtained as directed by your instructor.

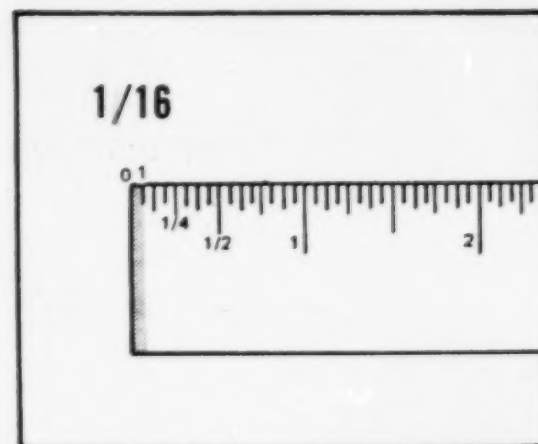
PROGRAMMED TEXT

Instructional Objective 1

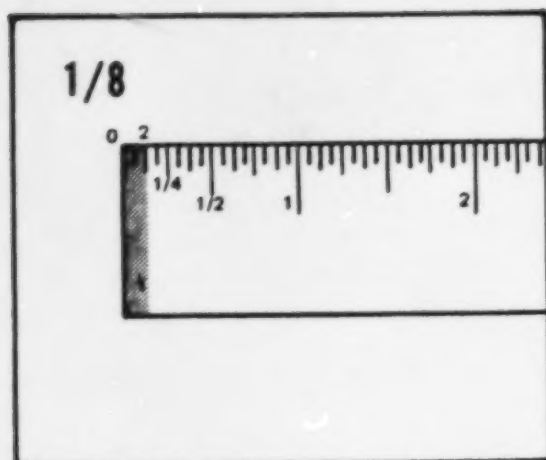
Using a metal rule, the student will be able to measure lengths and read dimensions.



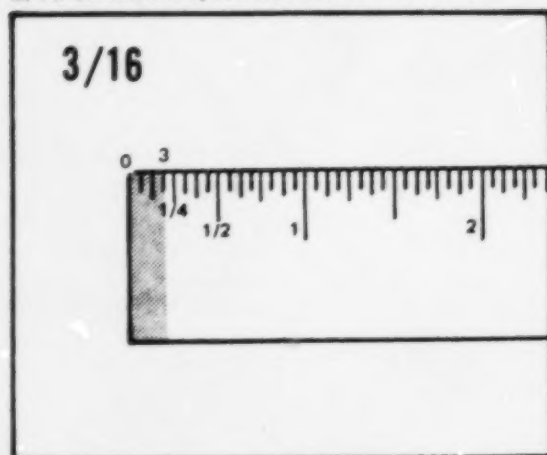
STEP 1 — To understand how to measure, you must understand the sixteen parts of an inch. This shows an inch broken down into 16 equal parts.



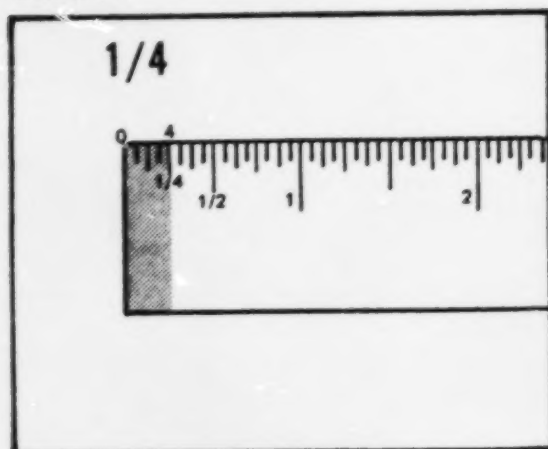
STEP 2 — From 0 to the mark labeled 1 is 1/16 inch.



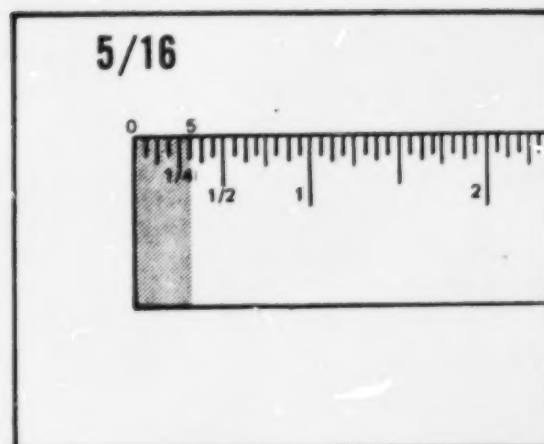
STEP 3 — From 0 to the mark labeled 2 is 2/16 or 1/8 inch; we will call it 1/8 inch.



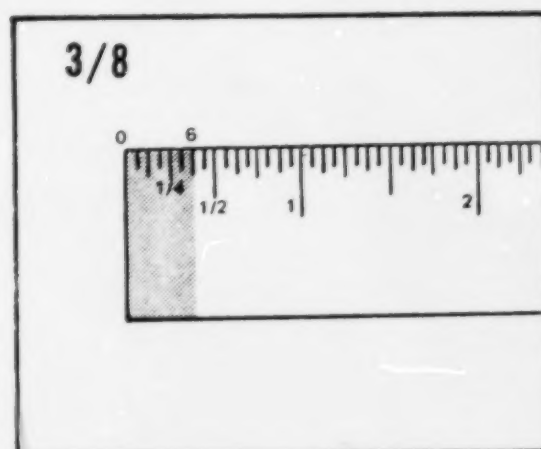
STEP 4 — From 0 to the mark labeled 3 is 3/16 inch.



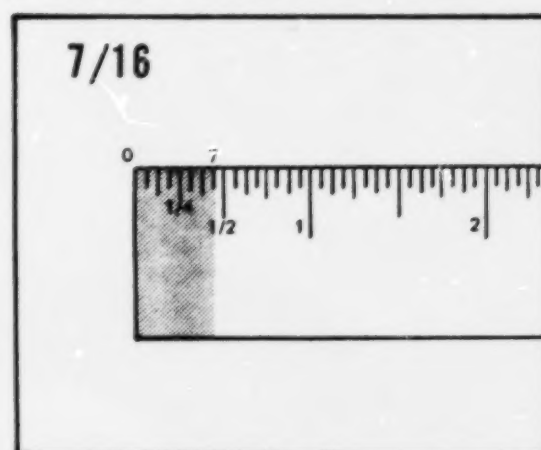
STEP 5 — From 0 to the mark labeled 4 is 4/16 inch or 1/4 inch; we will call it 1/4 inch.



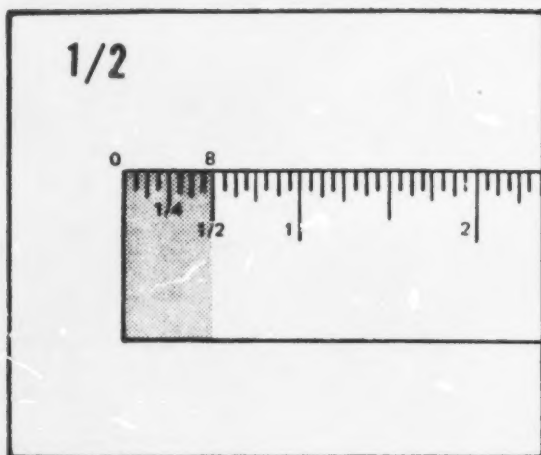
STEP 6 — From 0 to the mark labeled 5 is 5/16 inch.



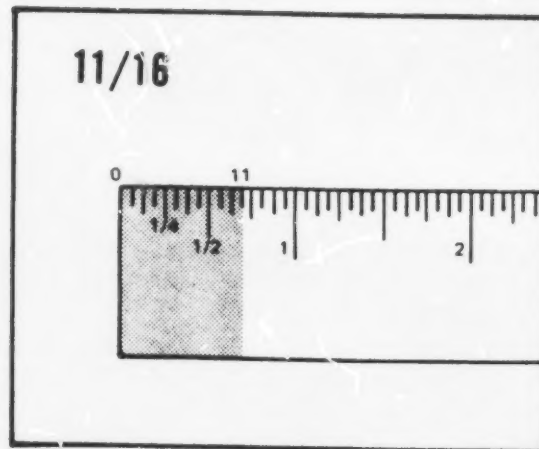
STEP 7 — From 0 to the mark labeled 6 is 6/16 or 3/8 inch; we will call it 3/8 inch.



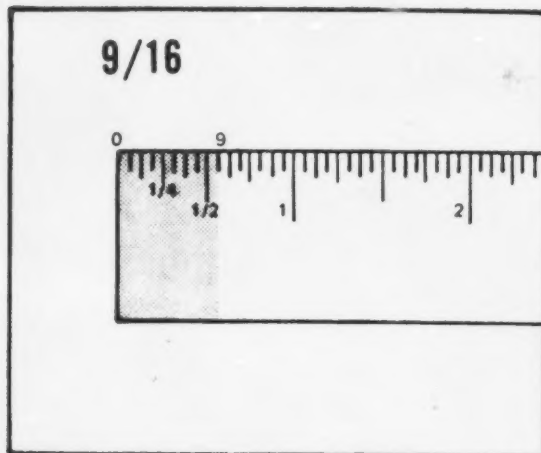
STEP 8 — From 0 to the mark labeled 7 is 7/16 inch.



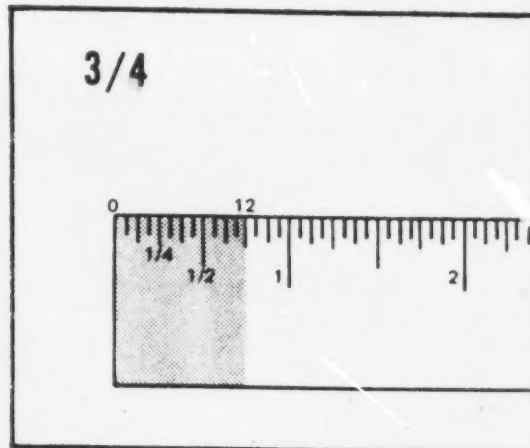
STEP 9 — From 0 to the mark labeled 8 is 8/16 inch, or 1/2 inch; we will call it 1/2 inch.



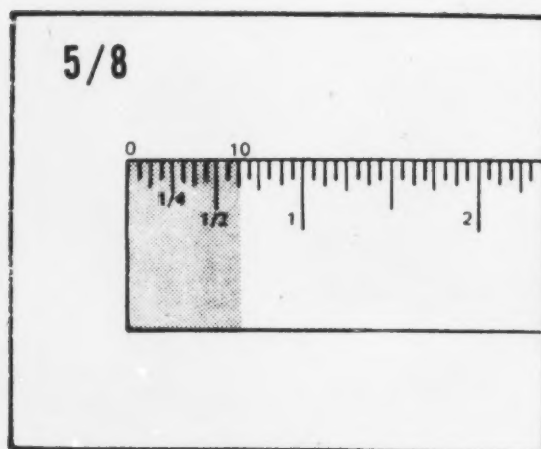
STEP 12 — From 0 to the mark labeled 11 is 11/16 inch.



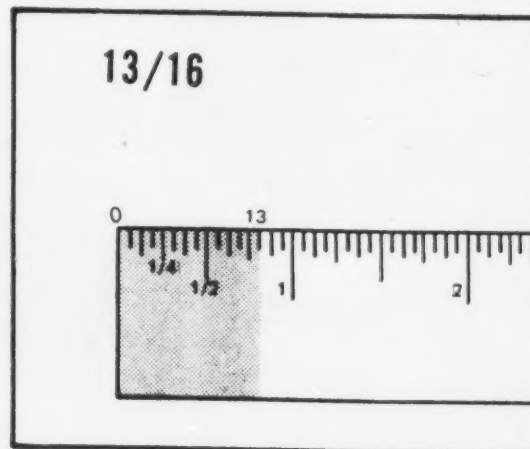
STEP 10 — From 0 to the mark labeled 9 is 9/16 inch.



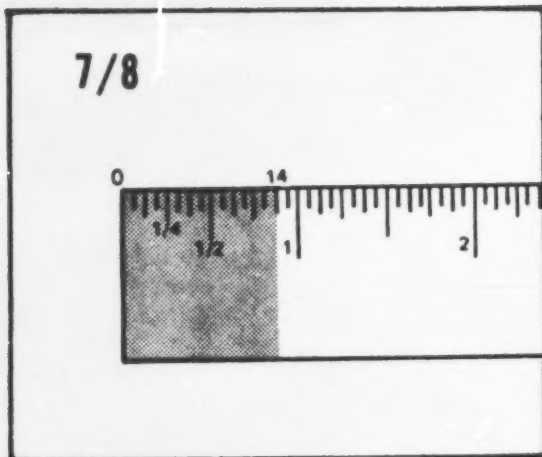
STEP 13 — From 0 to the mark labeled 12 is 12/16 or 3/4 inch; we will call it 3/4 inch.



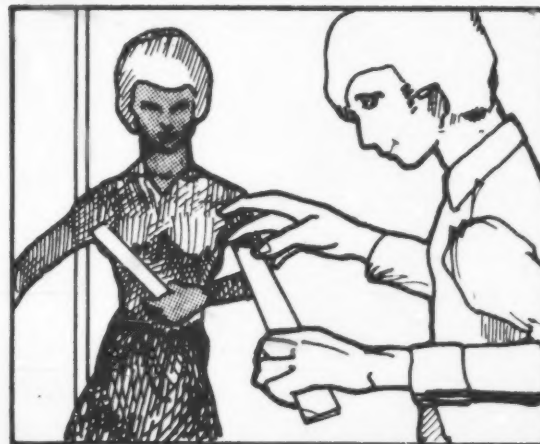
STEP 11 — From 0 to the mark labeled 10 is 10/16 inch or 5/8 inch; we will call it 5/8 inch.



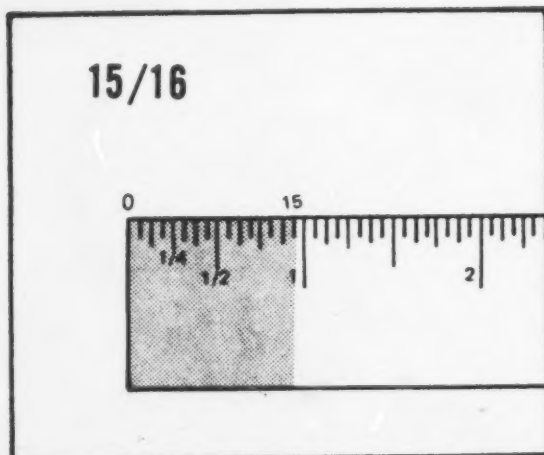
STEP 14 — From 0 to the mark labeled 13 is 13/16 inch.



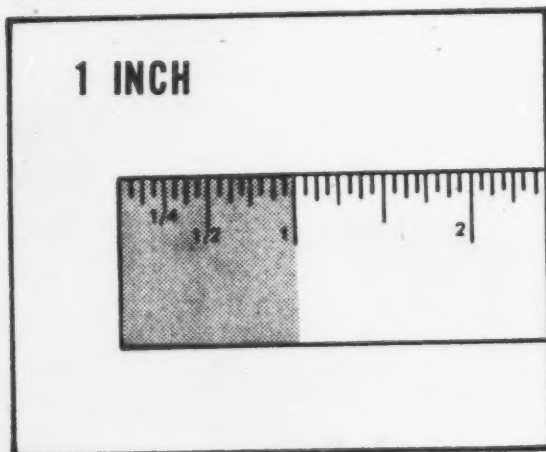
STEP 15 — From 0 to the mark labeled 14 is 14/16 or 7/8 inch; we will call it 7/8 inch.



STEP 18 — Look at the first inch on the metal rule.



STEP 16 — From 0 to the mark labeled 15 is 15/16 inch.



STEP 17 — From 0 to the mark labeled 16 is 16/16 or 1 inch.

Check Point

Using the metal rule and Student Answer Sheet, measure the lines to the right of the letters A, B, C, D,... Select the correct measurement and place the letter in the space to the right on Student Answer Sheet for Instructional Objective I.

- | | |
|-------------------|----------|
| A. $\frac{3}{4}$ | 1. _____ |
| B. 4 inch | 2. _____ |
| C. $\frac{1}{4}$ | 3. _____ |
| D. $1\frac{1}{2}$ | 4. _____ |
| E. $5\frac{1}{8}$ | 5. _____ |

STEP 19 — Check your answers.

1 — e, 2 — c, 3 — a, 4 — b, 5 — d

Instructional Objective II

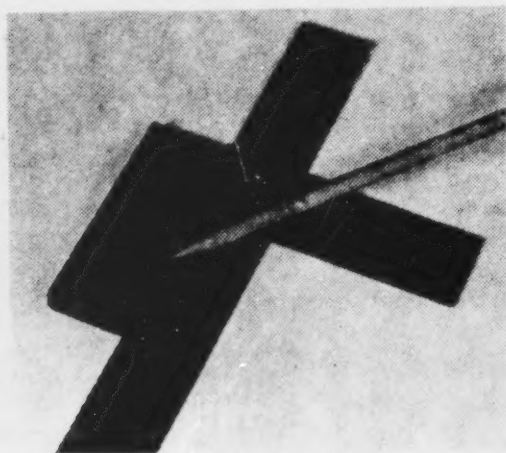
The student will be able to identify and use the five basic Layout Tools.



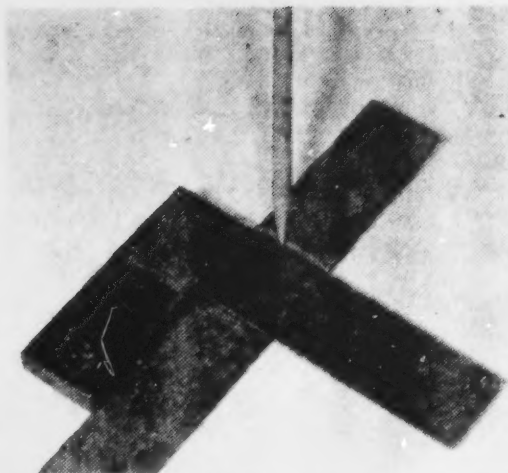
STEP 1 — The metal rule is 18 inches (45.72 cm) long and can be used as a straight edge for drawing lines.



STEP 2 — The second tool is the steel square. It is used to lay out and check right angles (90°).



STEP 3 — To use the square, place the handle against the edge of the metal.



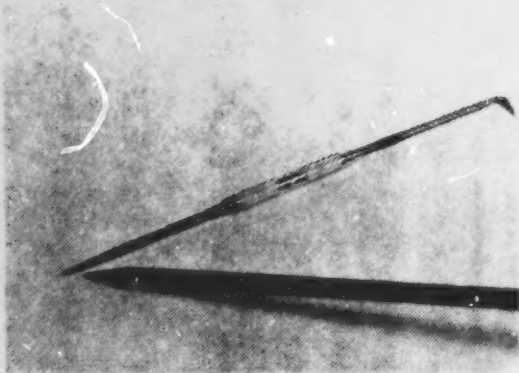
STEP 4 — The blade then lies across the metal. This lets you mark a line exactly 90° or a right angle.



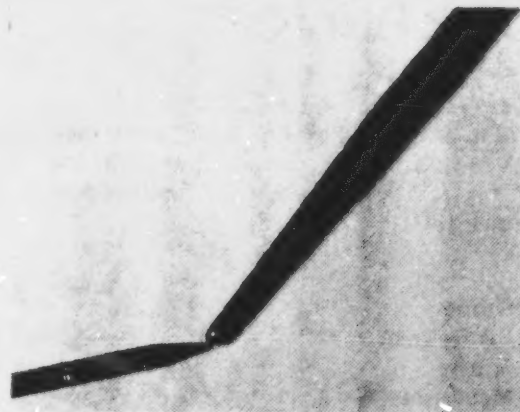
STEP 5 — The third layout tool is the scribe and it has two main parts.



STEP 6 — The first part is the handle— this is what you hold the scribe with; the second is the blade which has a sharp point and is used to scratch a mark or line on the surface of metal.



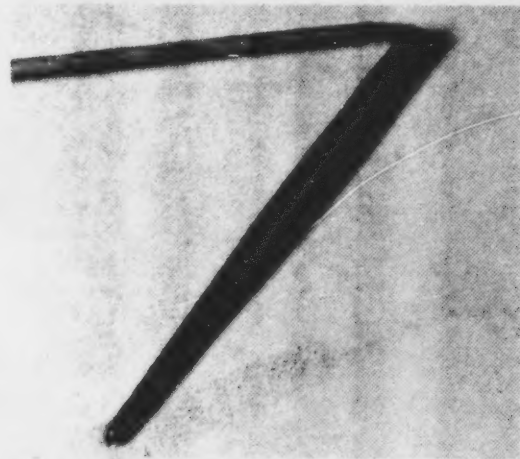
STEP 7 – SAFETY RULE: Since the scribe has a sharp point, caution must be observed. This point could punch a hole in your skin or cause eye damage.



STEP 10 – The point is sharp and it is placed on a mark.



STEP 8 – The fourth layout tool is the center punch. The punch has three main parts:



STEP 11 – The head is where you tap it with a hammer lightly to cause the point to make an indentation in the metal.



STEP 9 – Head, body and point. The body is what the punch is held by.

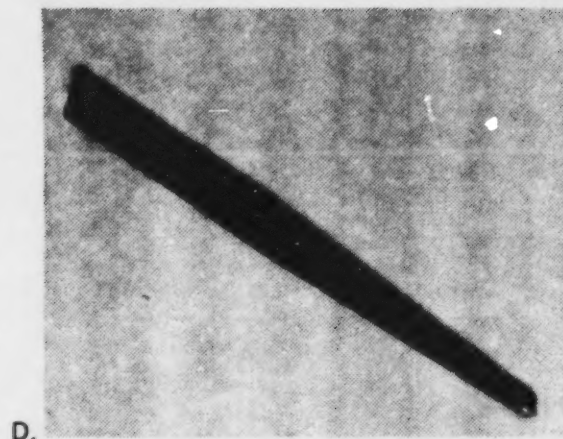
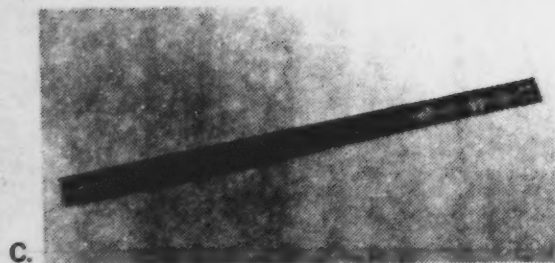
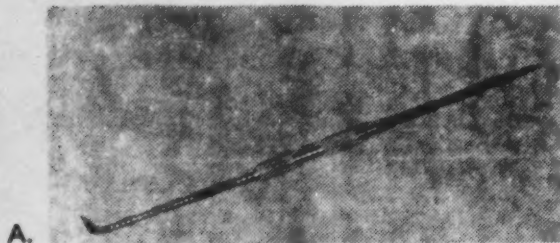


STEP 12 – The ball peen hammer is used to strike (hit) many of the metal working tools, for example the center punch.

Check Point

Match the following tools with their names by placing the correct letter in the blank on your answer sheet for Instructional Objective II.

1. Ball peen hammer
2. Scribe
3. Center punch
4. Square
5. Metal rule



STEP 13 — To check your answers: 1 - B, 2 - A, 3 - D, 4 - E, 5 - C

Instructional Objective III

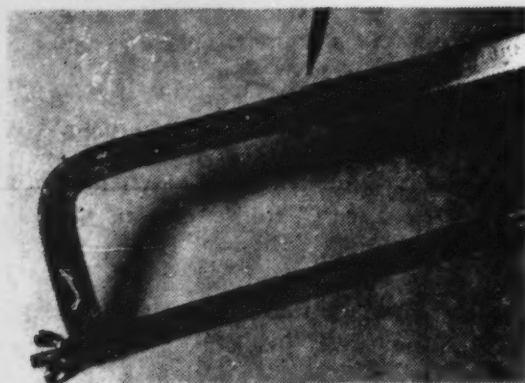
The student will become familiar with the parts of and the proper use of a hack saw.



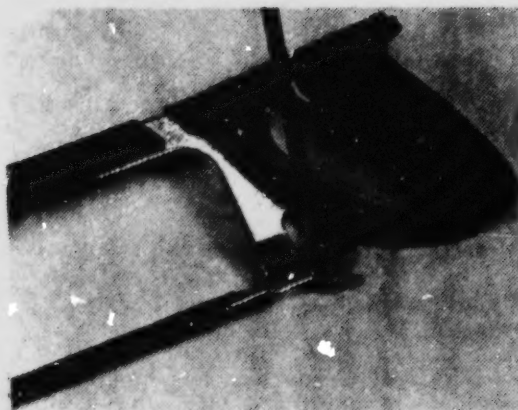
STEP 1 — The hacksaw has four major parts: The handle, frame, tension adjustment and the blade.



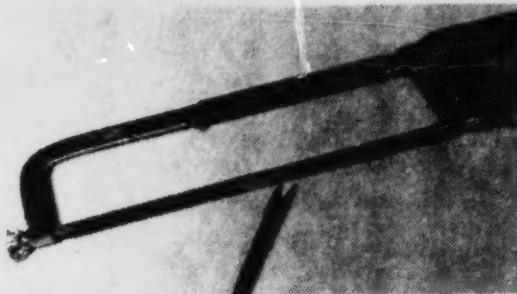
STEP 2 — The handle is shaped like a pistol grip to fit easily in the hand and make it more comfortable to use.



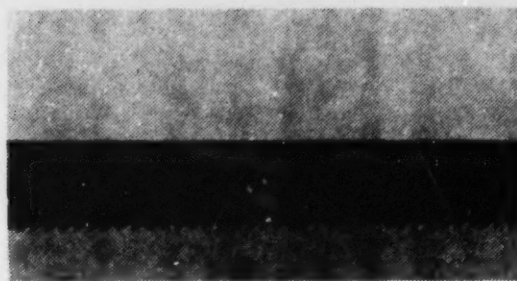
STEP 3 — The frame is shaped similar to the letter "U." IT IS ADJUSTABLE AND CAN BE SET TO FIT BLADES OF VARIOUS LENGTHS.



STEP 4 — The tension adjusting unit consists of wing nut and a sliding bolt. Its purpose is to apply tension on the blade.



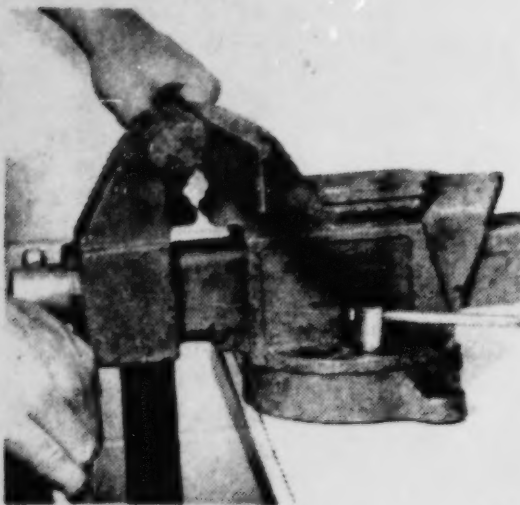
STEP 5 — The blade is $\frac{1}{2}$ inch wide (1.27 cm) and it is .025 inches thick. The length can be either 8 inches (20.32 cm), 10 inches (25.4 cm), 12 inches (30.48 cm). The steel in a metal cutting saw blade must be harder than the metal to be cut, therefore, these blades are made of hardened steel. The size of teeth varies according to the number of teeth per inch.



STEP 6 — Pick the saw up and check to see that the blade is inserted correctly.



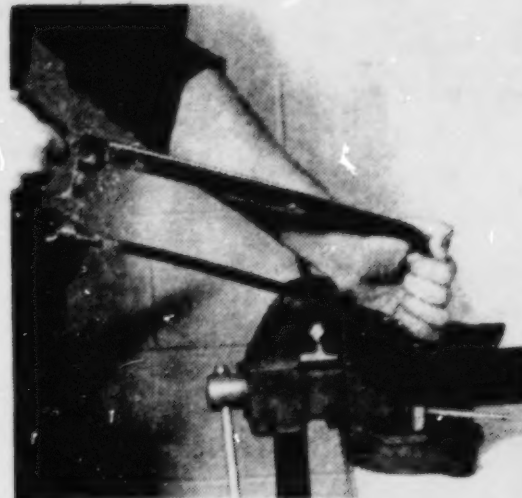
STEP 7 — Check the blade tension and adjust it, if needed, by turning the wing nut on the blade tension adjustment.



STEP 8 — The metal to be cut should be put in a vise.



STEP 9 — To start a cut, the blade should be placed on the metal with as many teeth as possible touching the metal.



STEP 10 — Stand in a relaxed position at the vise and hold the saw correctly.



STEP 11 — Put the saw blade down against the metal. Push the saw forward and apply just enough pressure to cause the blade to cut the metal.

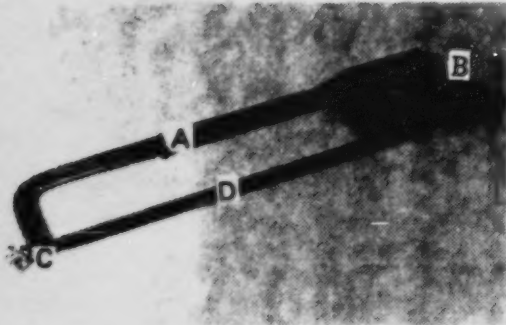
STEP 12 — Continue sawing with a light pressure until the cut is started. Do not use a rapid, jerky sawing motion; use a smooth back-and-forth motion, with a full stroke of the blade.

STEP 13 — Use less pressure on the saw when the cut is almost through the metal.

Check Point

Match the parts of the hack saw with the correct name by placing the letter in the blank on your answer sheet for Instructional Objective III.

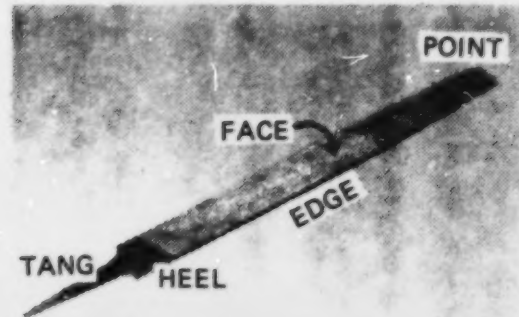
1. Tension adjustment
2. Blade
3. Frame
4. Handle



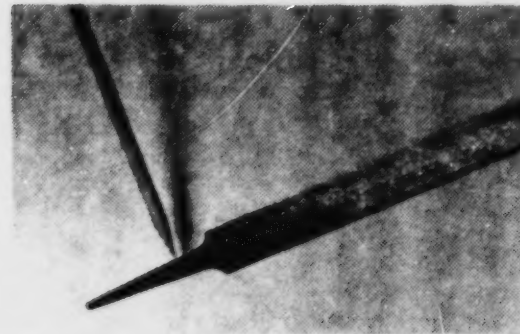
STEP 14 — To check your answers: 1 - C, 2 - D, 3 - A, 4 - B.

Instructional Objective IV

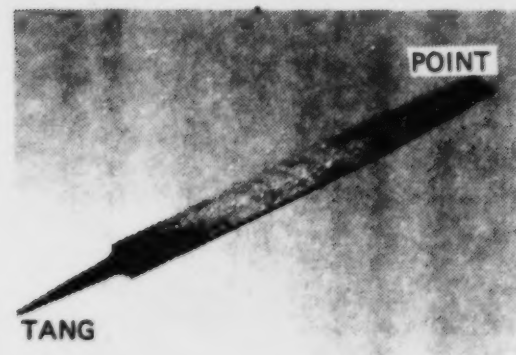
The student will identify the parts of a file and proper use of the file.



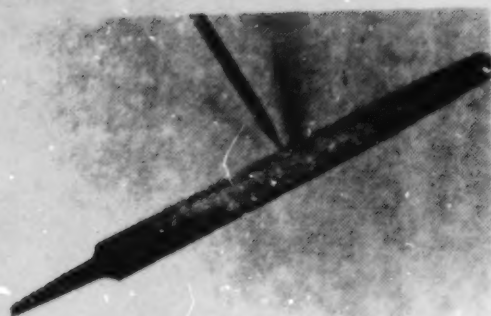
STEP 1 — There are five parts of a file: the point, face, edge, heel, and tang.



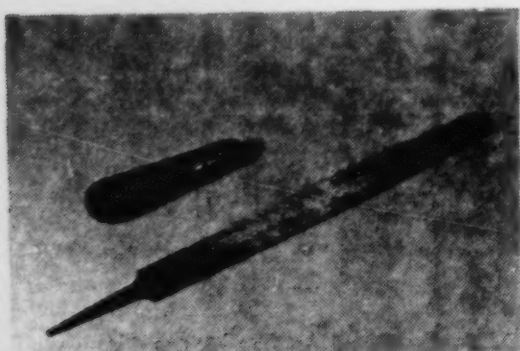
STEP 2 — The tang is the narrow end of a file where the handle is fastened.



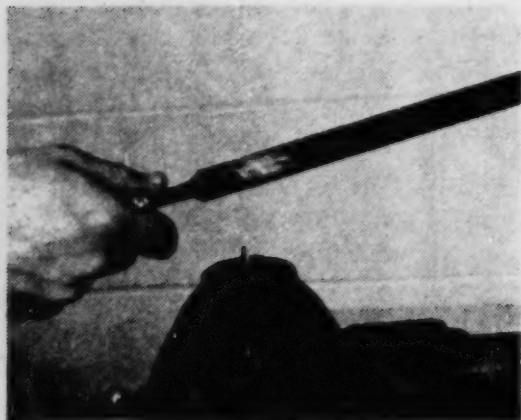
STEP 3 — The size of a file is the length measured from the end of the point to the end of the tang.



STEP 4 — The teeth of the file are made of hardened steel because they must be harder than the metal being filed. The teeth do the cutting.

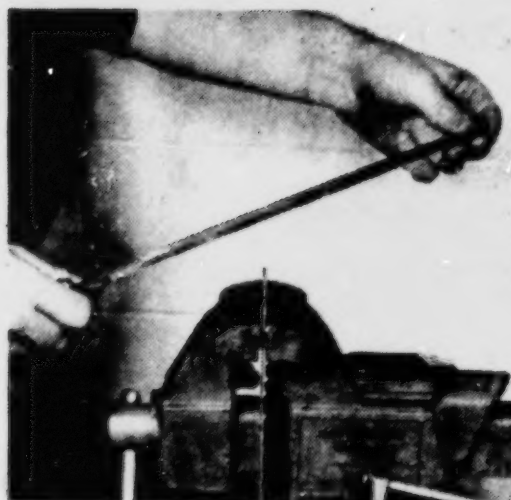


STEP 5 — A wooden handle fits on the tang and is tightened by tapping it on a table or floor.



STEP 6 — Hold the handle in either the right or left hand according to which you favor.

SAFETY NOTE: To avoid injury always use the file with the handle tightly secured to the tang.

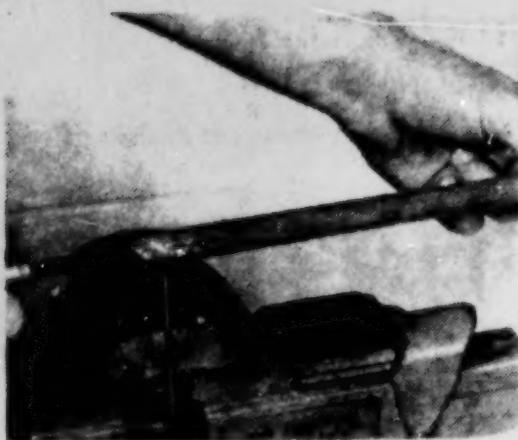


STEP 7 — Grab the point with the thumb and first two fingers of the other hand.

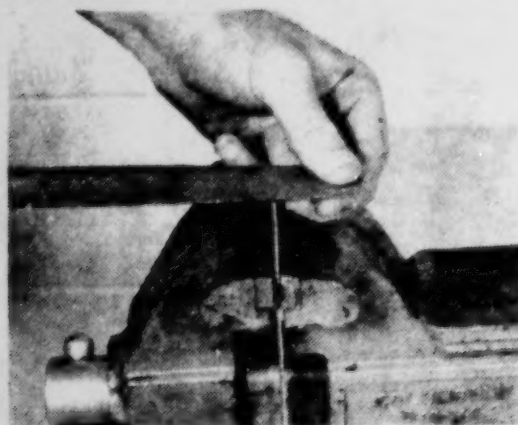


STEP 8 — Stand in a relaxed position.

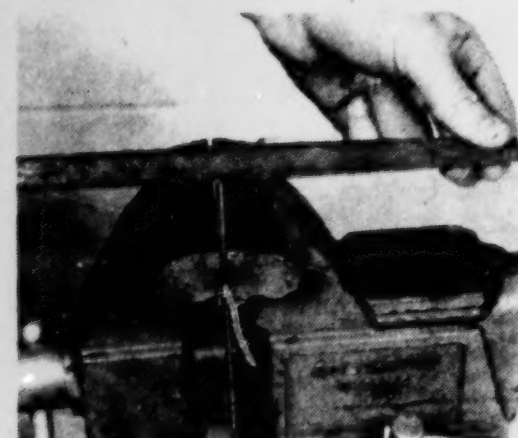
STEP 9 — Place the file flat on the metal with the teeth pointing to the front.



STEP 10 — Keep the file level and push it across the metal.



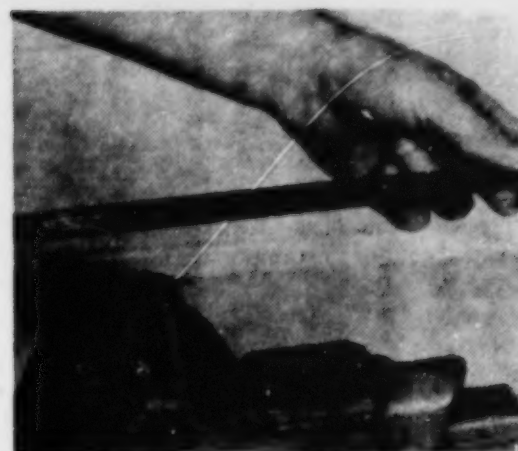
STEP 11 — Apply more pressure with the hand in front at the start of the stroke.



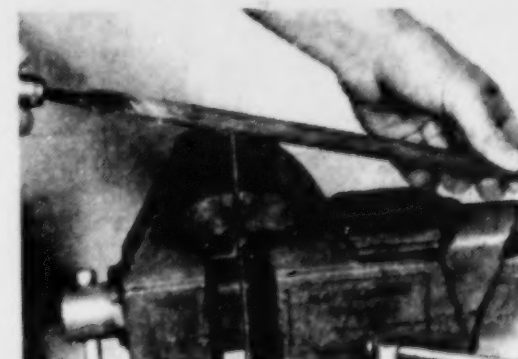
STEP 12 — Release some of the pressure of the front hand when the file reaches the center.



STEP 13 — Apply more pressure with the back hand for the rest of the stroke.



STEP 14 — The file cuts only in one direction on the forward stroke. It should be lifted on the return stroke.



STEP 15 — Keep the file from rocking on the metal; this is the most common error.

SAFETY NOTE: To avoid injury always use the file with the handle tightly secured to the tang.

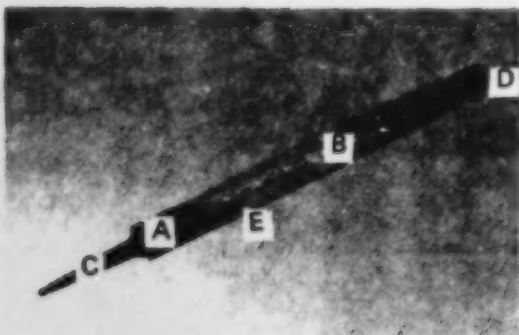


STEP 16 — Cleaning a file is done with a file card.

Check Point

Match the parts of a file with the correct name by placing the letter in the blank on the answer sheet for Instructional Objective IV.

- 1 — Tang
- 2 — Face
- 3 — Point
- 4 — Edge
- 5 — Heel



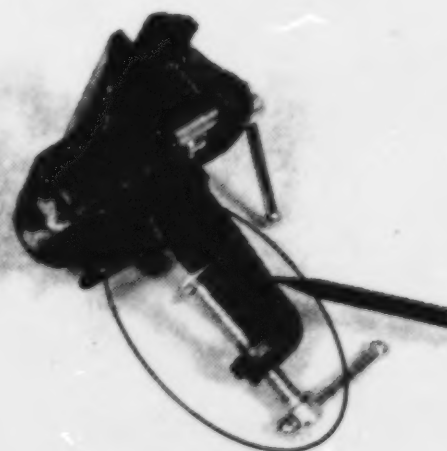
STEP 17 — To check your answers: 1 - C, 2 - B, 3 - D, 4 - E, 5 - A.

Instructional Objective V

The student will identify the parts of a vise and will learn how to use the vise.



STEP 1 — There are four basic parts to a vise, the handle, table clamp, jaws, and body.



STEP 2 — The table clamp is adjustable so that it will fit different tables. The adjustment has a bolt going through it which, when run in, tightens on the table.



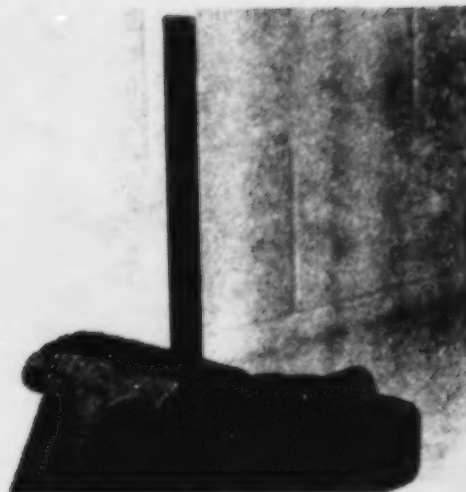
STEP 3 — The handle is on the end of a big bolt which tightens or loosens the vise.



STEP 4 — The body is the largest part of the vise; it gives the vise strength.



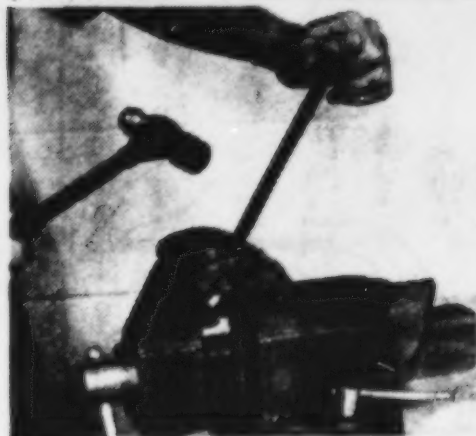
STEP 5 — The jaws are what clamp the metals in place.



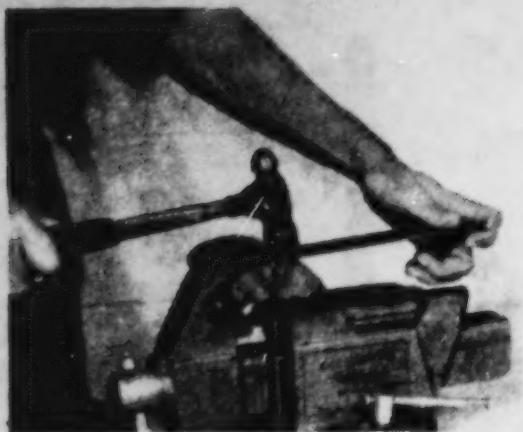
STEP 6 — Using a vise to bend metal, place the metal in the vise and tighten the jaws against the metal.



STEP 7 — Pick up the 8 oz. (226.8 g) ball peen hammer.



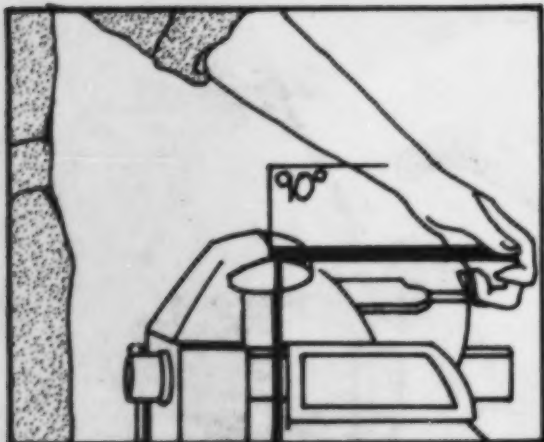
STEP 8 — Start the bend by lightly hitting the metal close to the jaws.



STEP 9 — Continue tapping the metal until it is bent down to 90° or a right angle.



STEP 10 — Take the metal out of the vise and check it with a square.



STEP 11 — If the metal is not 90° , put it back in the vise with the bend parallel to the jaws.

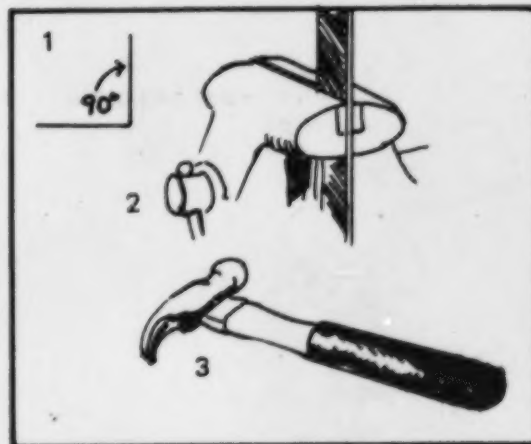


STEP 12 — Tap it with the hammer and then check it with the square.

Check Point

Answer the following questions with either a YES or a NO in the blank on your Student Answer Sheet for Instructional Objective V.

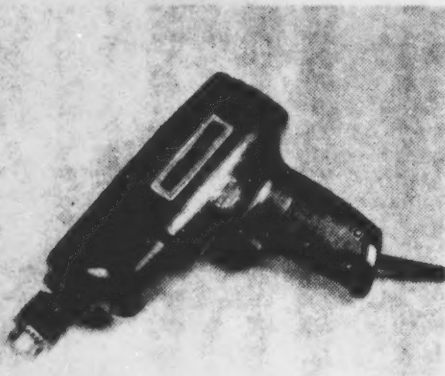
- (1) This is a right angle
- (2) This is the correct way to put metal in a vise before bending it.
- (3) This is the correct hammer to use when bending metal.



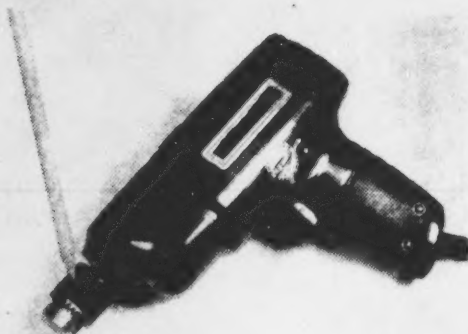
STEP 13 — When you have answered the questions, check your answers. 1 — yes, 2 — yes, 3 — no.

Instructional Objective VI

The student will identify the parts of a 3/8 inch hand power drill, learn how to use the drill correctly, and the safety rules which are observed when using a drill.



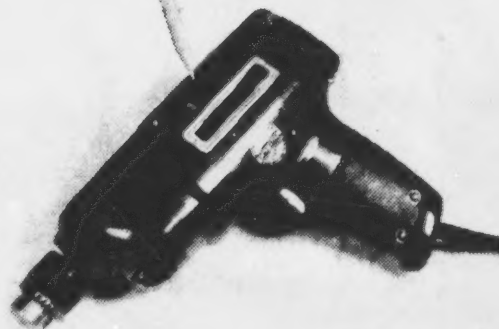
STEP 1 — The parts of a 3/8 inch hand drill are the chuck, trigger switch, handle, power cord, and chuck key.



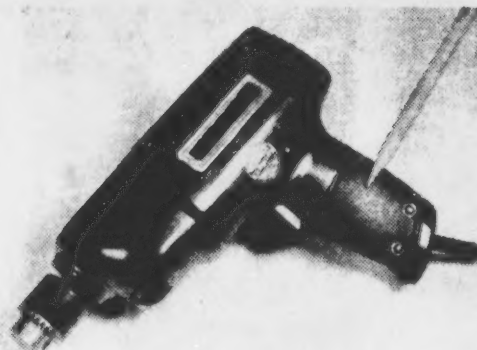
STEP 2 — The chuck holds the drill bit and it is tightened with the chuck key.



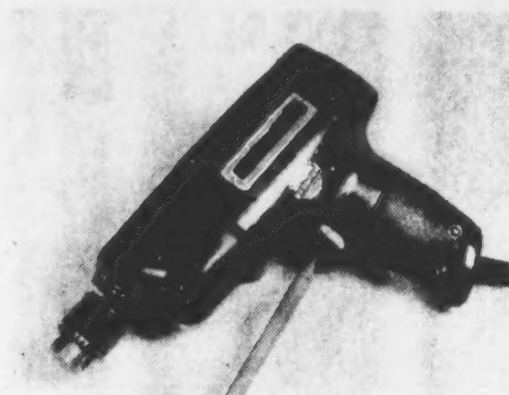
STEP 3 — The chuck key fits in the chuck.



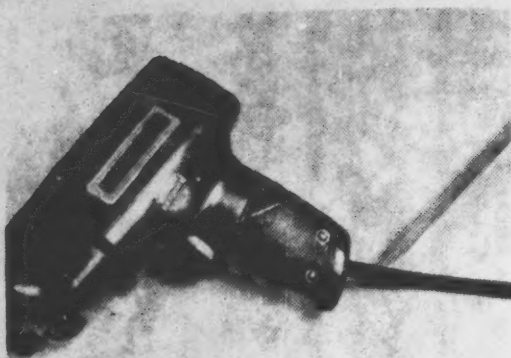
STEP 4 — The frame of the drill protects the electric motor which drives the drill.



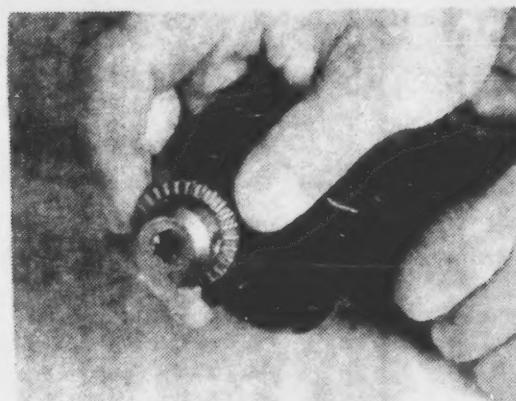
STEP 5 — The handle is used to hold the drill.



STEP 6 — The trigger switch is mounted in the handle; it is spring loaded to turn the drill off when you release the trigger.



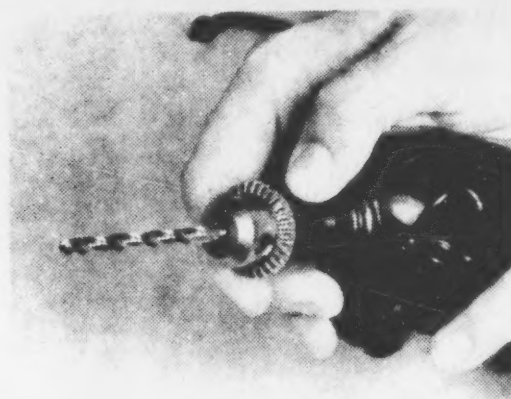
STEP 7 — The power cord is used to plug the drill into a wall outlet.



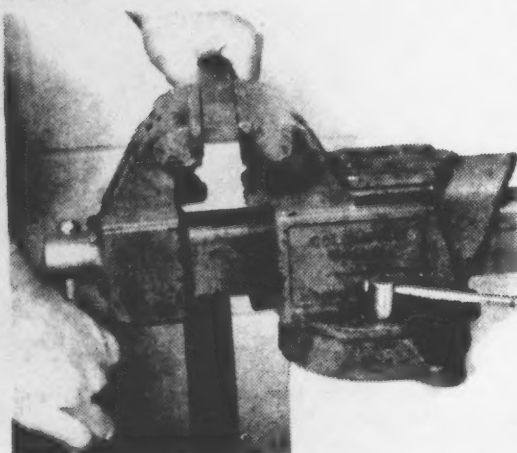
STEP 10 — To put a drill bit in a drill, the chuck may need to be loosened.



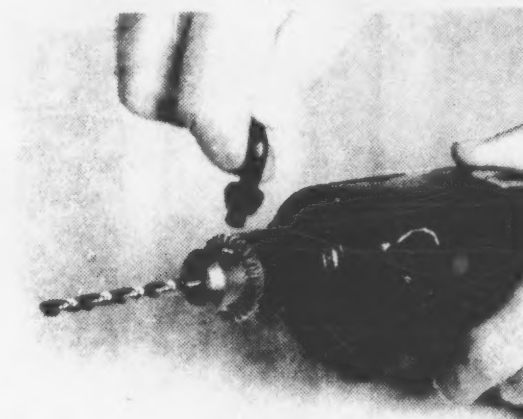
STEP 8 — REMEMBER THIS SAFETY RULE. Always wear safety glasses when using a drill.



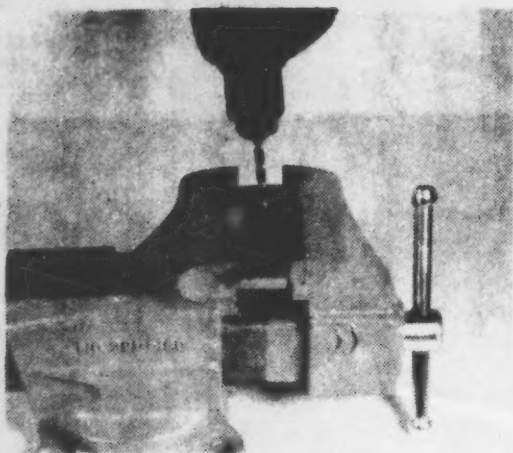
STEP 11 — Put the bit in the drill with sharp point out, then tighten chuck against the bit.



STEP 9 — REMEMBER THIS SAFETY RULE. Always put the metal to be drilled in a vise.

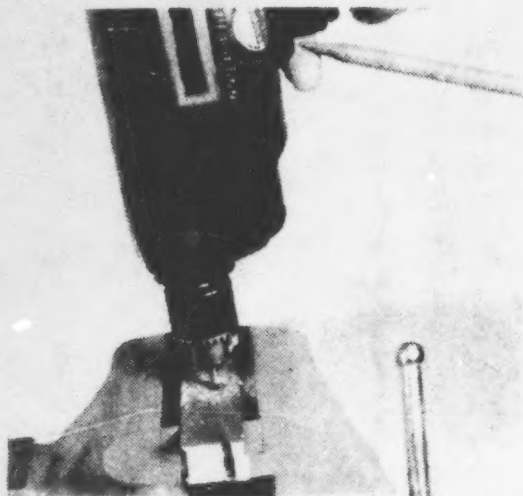


STEP 12 — Remember to remove chuck key before starting drill.



STEP 13 — Put the drill bit point against the metal to be drilled and hold the drill straight.

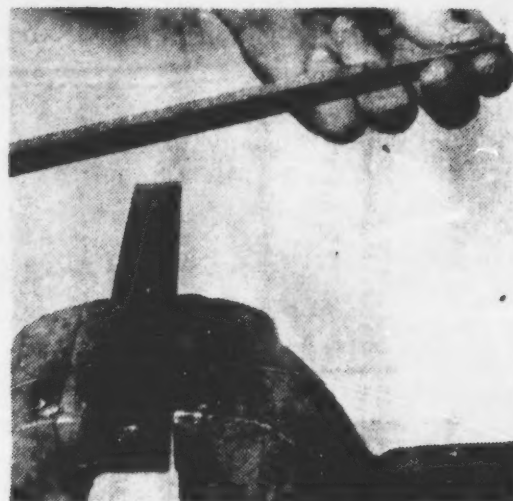
STEP 14 — The drill should be 90° to the metal.



STEP 15 — Drill the hole; when the bit goes through the metal, release the trigger to stop the drill.



STEP 16 — Pull the drill upward taking the bit out of the hole.



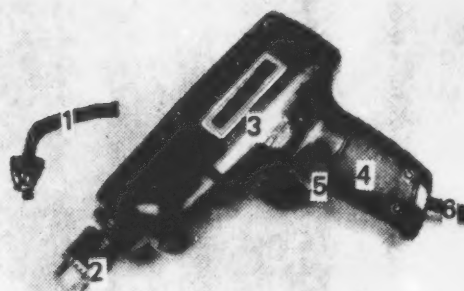
STEP 17 — There will be burrs on the bottom of the metal where the hole was drilled.

STEP 18 — Use a file to remove the burrs.

Check Point

Identify the following parts of a power hand drill on your answer sheet.

- A. Handle
- B. Trigger Switch
- C. Electric Cord
- D. Chuck Key
- E. Chuck
- F. Frame

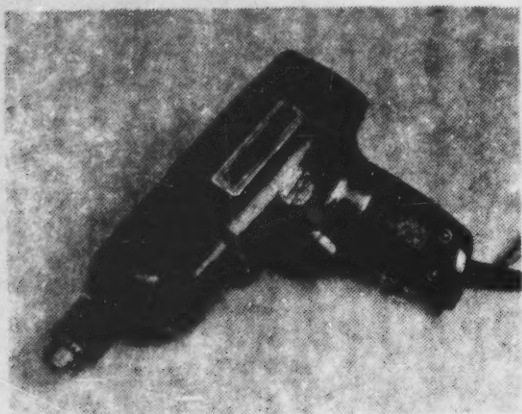


STEP 19 — When you have completed check-point, check your answers with the ones below.

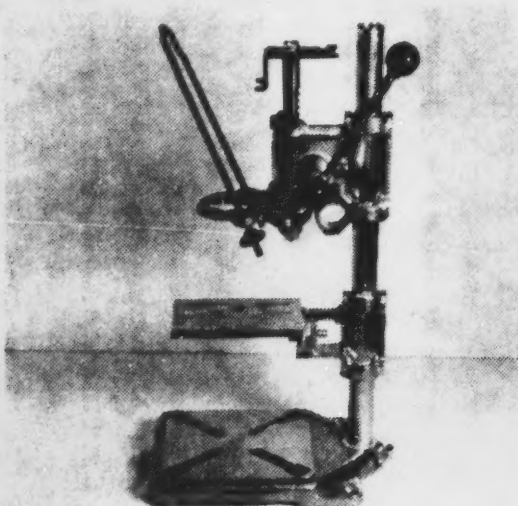
- A - 4
- B - 5
- C - 6
- D - 1
- E - 2
- F - 3

Instructional Objective VII

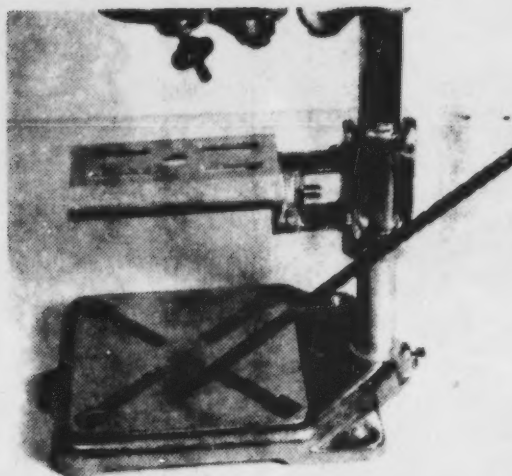
The student will identify the parts of a table mounted drill press and learn how to use it correctly.



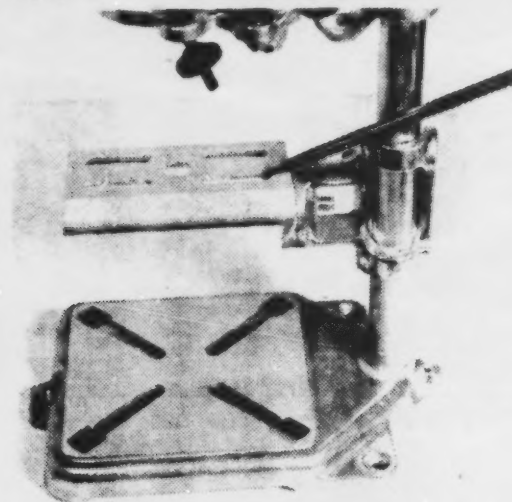
STEP 1 — The drill stand is made to hold either a 1/4 inch or 3/8 inch hand drill.



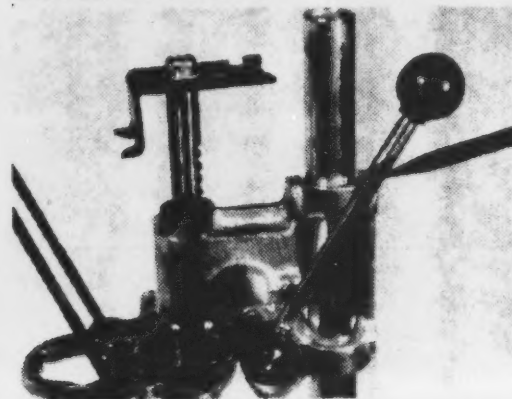
STEP 2 — There are five basic parts of the drill stand — the stand, bed, feed arm, depth gauge, and drill clamp.



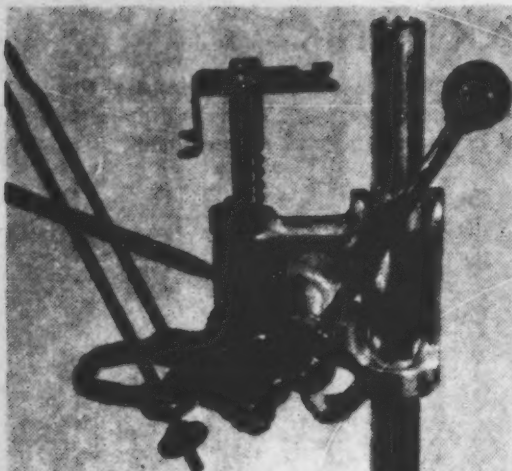
STEP 3 — The stand balances the rest of the equipment while it sits on the table.



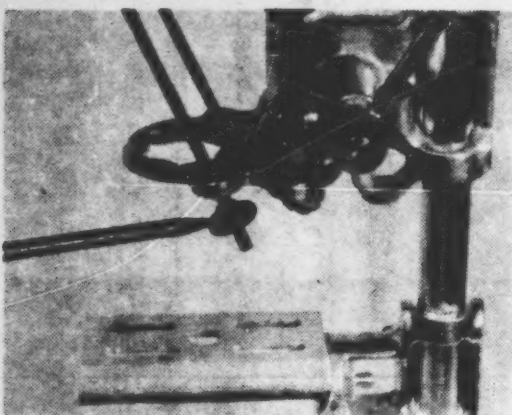
STEP 4 — The bed is where the vise is bolted and the height can be adjusted by a nut on the side near the shaft.



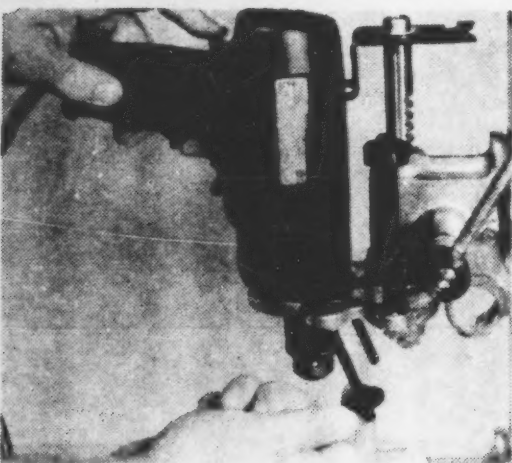
STEP 5 — The feed arm controls the up and down movement of the drill.



STEP 6 — The depth gauge sets the depth the drill will go down.



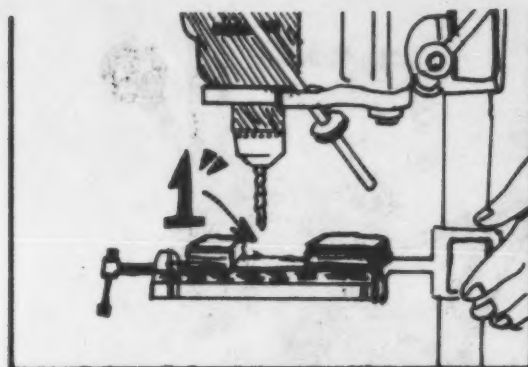
STEP 7 — The clamp for the drill is tightened by thumb screws on the bottom of the clamp.



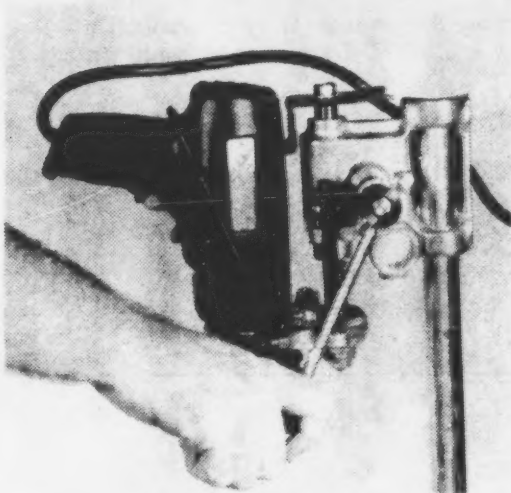
STEP 8 — Put the 3/8 inch drill in the drill stand. Tighten the screws.



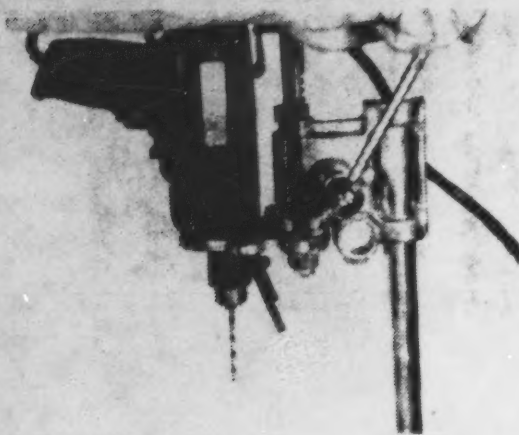
STEP 9 — Put a bit in the drill chuck.



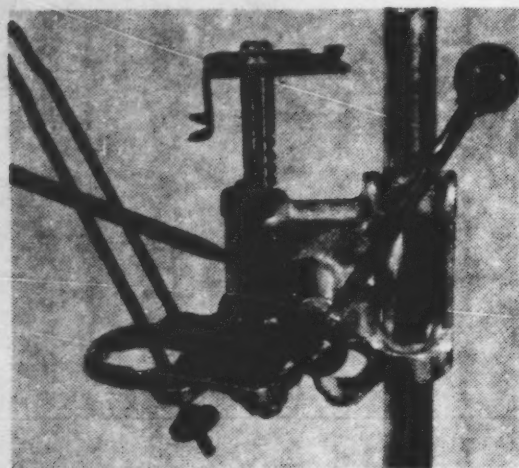
STEP 10 — Adjust bed height so that vise is about 1" (2.54 cm) below the point of the drill bit.



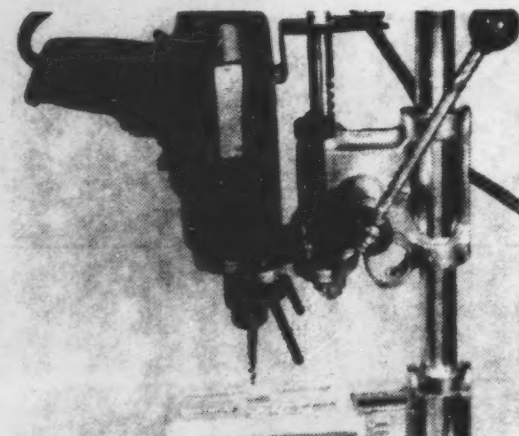
STEP 11 — Grab feed handle and pull it down gently.



STEP 12 — Let the feed handle back up easily.



STEP 13 — If the depth gauge will not let the bit go down far enough to drill through a piece of metal 1" (2.54 cm) thick, adjust it lower.

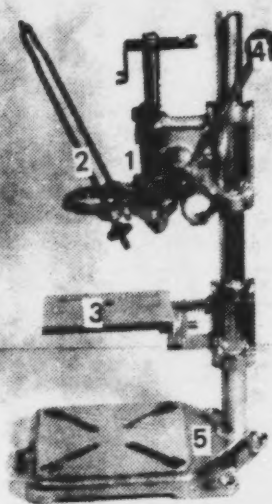


STEP 14 — You are now ready to drill a hole.

Check Point

Match the parts of the drill stand with the correct name by placing the number in the blank on your Student Answer Sheet.

- A. Bed
- B. Drill clamp
- C. Depth gauge
- D. Feed arm
- E. Stand

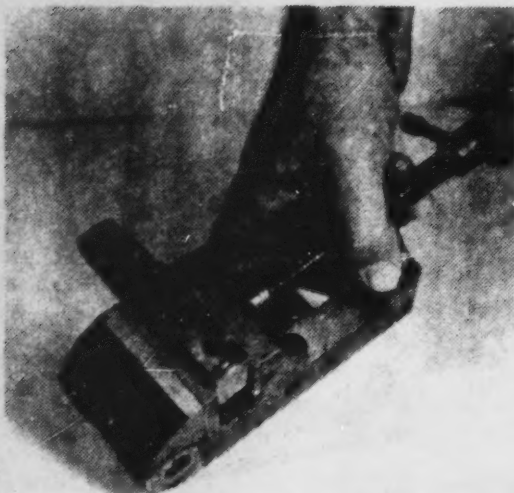


STEP 15 — When you have completed this answer sheet, check your answers.

- A - 3
- B - 2
- C - 1
- D - 4
- E - 5

Instructional Objective VIII

The student will identify the parts of and use of a tap.

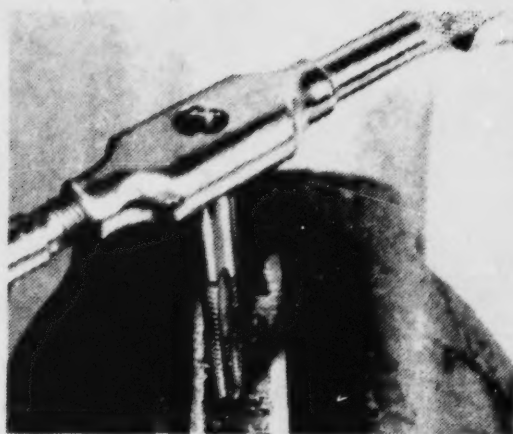


STEP 1 — Before a hole can be tapped out, it must be drilled to the correct size.



STEP 2 — The size of a tap and the hole size is always stamped on the tap.

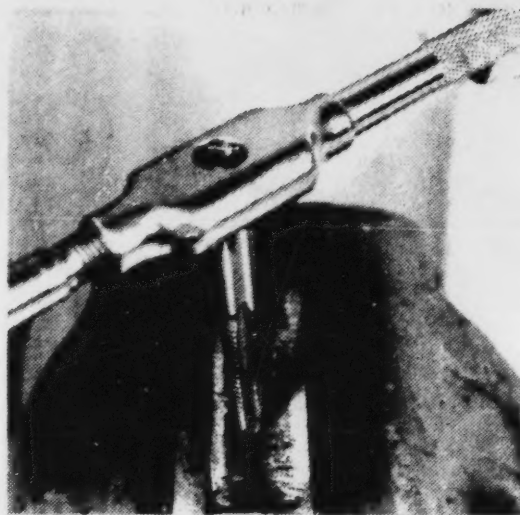
STEP 3 — For example, $\frac{3}{8}$ " - 16 NC - $\frac{5}{16}$ ". This means the threads will be $\frac{3}{8}$ " with 16 threads per inch and the hole size is to be drilled $\frac{5}{16}$ of an inch (.79375 cm).



STEP 4 — When the hole is drilled, it is smaller than the tap so the threads can be cut.



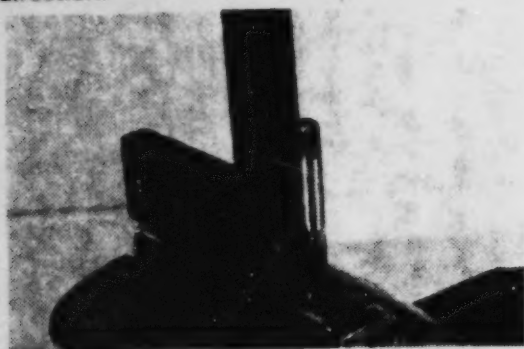
STEP 5 — Put the square end of the tap in the tap handle and tighten it.



STEP 6 — Put the point of the tap in the hole keeping it straight.



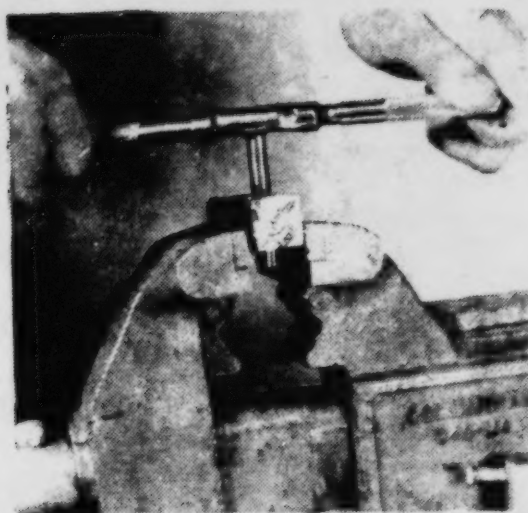
STEP 7 — Turn the tap in a clockwise direction.



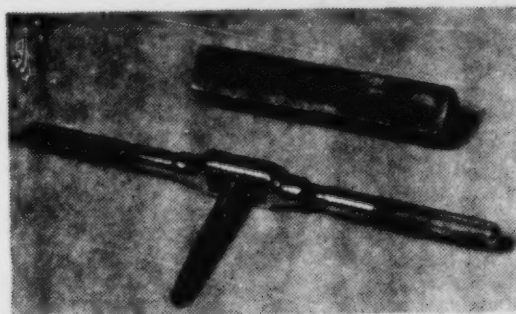
STEP 8 — When the tap is started, check it with a square to see if it is straight.



STEP 9 — If so, continue turning the tap. For each full turn, back the tap up $\frac{1}{4}$ of a turn to break off the chips of metal in the tap.



STEP 10 — Continue this procedure until the hole is threaded all the way through.



STEP 11 — Remove the tap and lay it down.

Check Point

Match the parts of the tap with the correct name by placing the number in the blank on your student Answer Sheet.

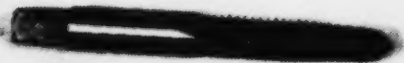
- A Tap
- B Size hole to drill
- C Size threads per inch
- D Tap handle



1

$\frac{3}{8}$ -16 NC $\frac{5}{16}$

2  3 



4

STEP 13 — When you have completed the identification, check your answers.

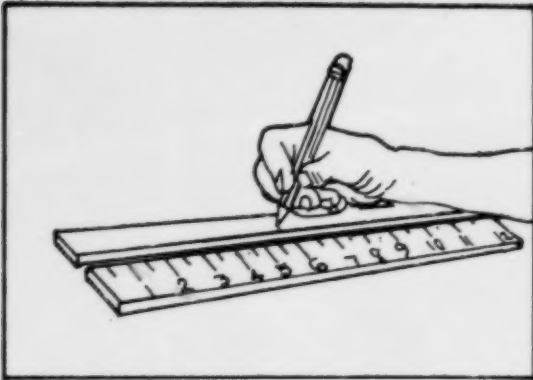
- A - 4
- B - 3
- C - 2
- D - 1

INSTRUCTION

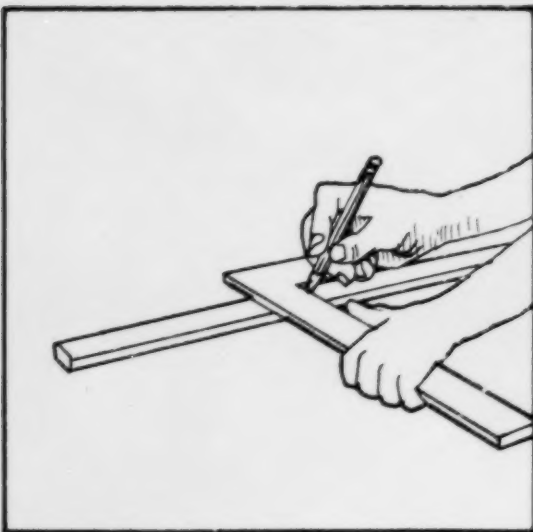
This section will be concerned with measuring, cutting, drilling, and tapping threads, using a die to cut threads and with putting together an adjustable gear puller. Follow the step-by-step instructions.

Instructional Objective IX

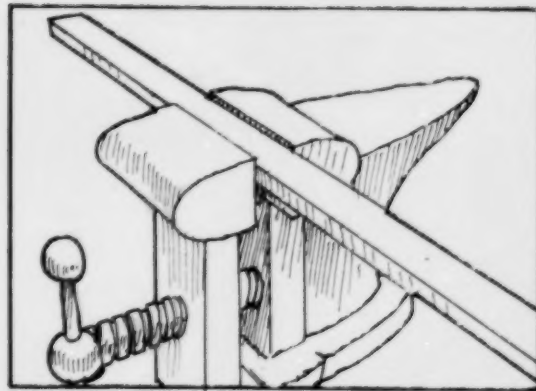
Given tools and equipment, the student will measure and cut out stock.



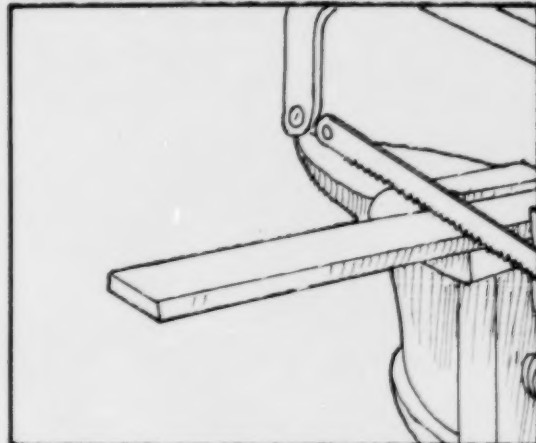
STEP 1 — Using the rule, measure and mark 6 inches (15.24 cm) on a piece of $\frac{3}{4} \times \frac{1}{4}$ inch metal.



STEP 2 — Using the square, scribe a mark across the metal at the 6 inch (15.24 cm) mark.



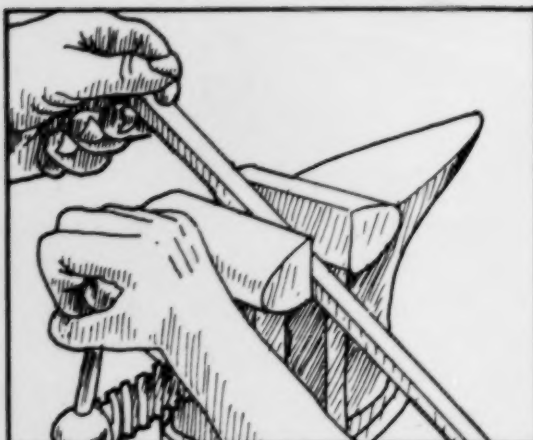
STEP 3 — Secure the metal in a vise with the scribed line on top; allow about 1 inch to extend from the jaws of the vise.



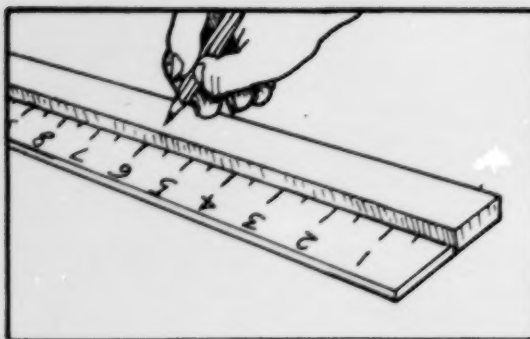
STEP 4 — Place the saw on the mark.

**LONG
EVEN
STROKES**

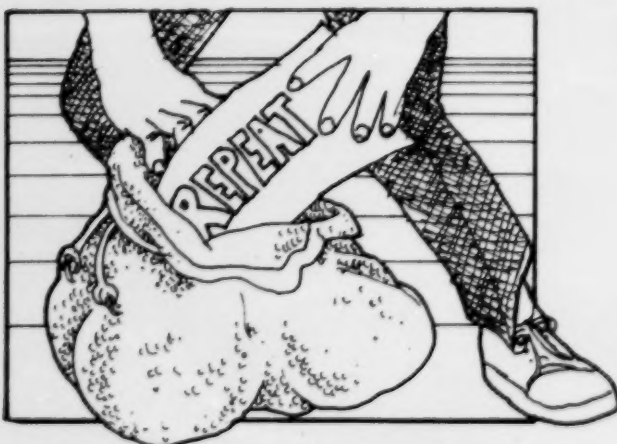
STEP 5 — Cut the metal by using long even strokes. Lay the saw down.



STEP 6 – Take the metal out of the vise.



STEP 7 – Mark another piece of $\frac{3}{4}$ x $\frac{1}{4}$ inch flat metal 6 inches (15.24 cm) long.



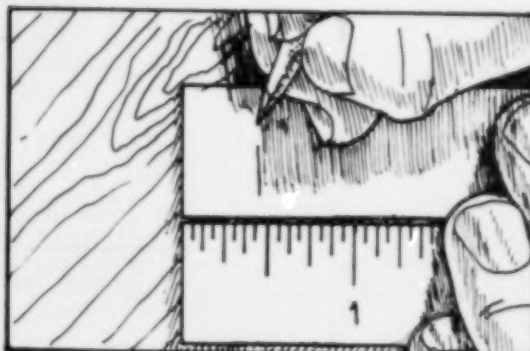
STEP 8 – Repeat steps 2, 3, 4, 5 and 6.

Check Point

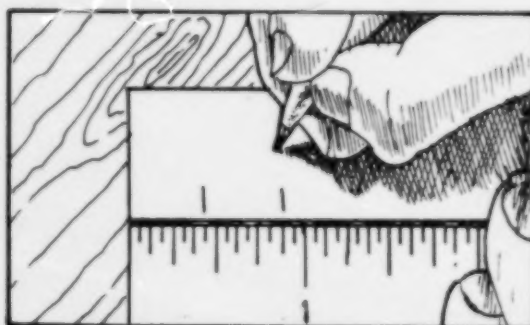
Check each end of the metal with a square to see that it is cut square. If not, put the metal back into the vise with the end sticking up about $\frac{1}{2}$ inch above the vise. File each end until it is square.

Instructional Objective X

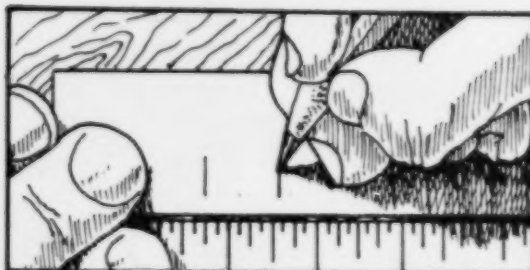
Given the proper tools and equipment, each student will locate the position of holes to be drilled in the metal used in Objective IX.



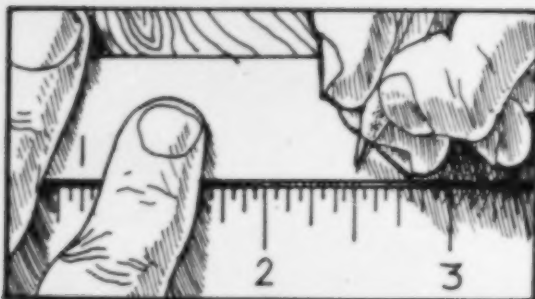
STEP 1 – Pick up a piece of metal and measure and mark $\frac{7}{16}$ inch (1.11 cm) (see working drawing handout).



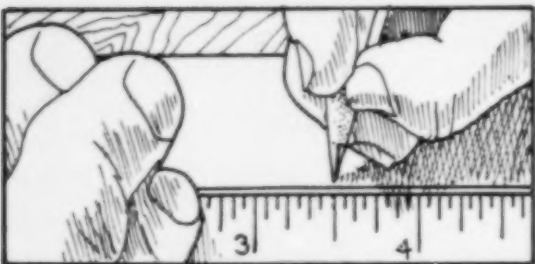
STEP 2 – Measure over $\frac{7}{16}$ inch (1.11 cm) from the first mark and put a second mark.



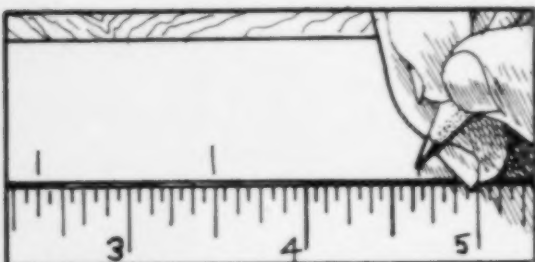
STEP 3 – Measure (from this second mark) over $\frac{7}{16}$ inch (1.11 cm) and put a third mark.



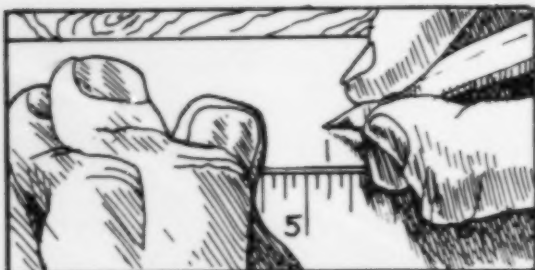
STEP 4 — Measure (from the third mark) over 1-3/16 inch (3.02 cm) and put a fourth mark.



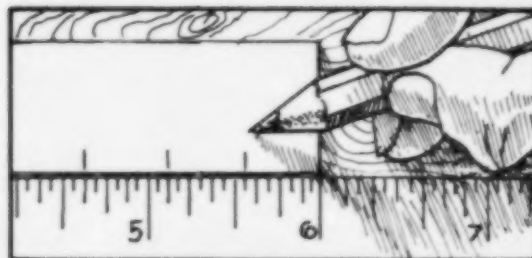
STEP 5 — Measure (from the fourth mark) over 1 inch (2.54 cm) and put the fifth mark.



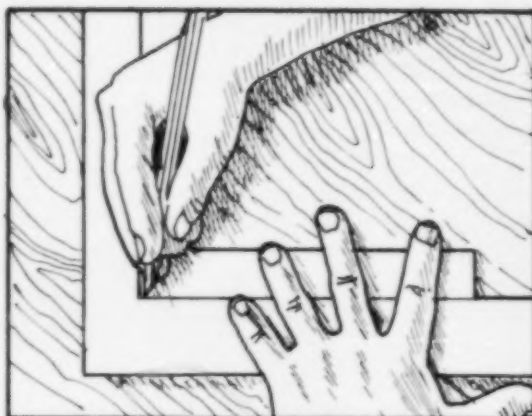
STEP 6 — Measure (from the fifth mark) over 1-3/16 inch (3.02 cm) and put the sixth mark.



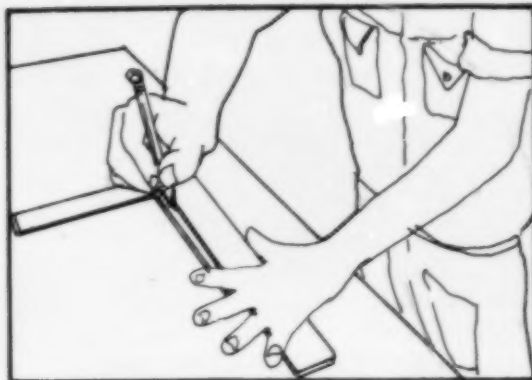
STEP 7 — Measure (from the sixth mark) over 7/16 inch (1.11 cm) and put the seventh mark.



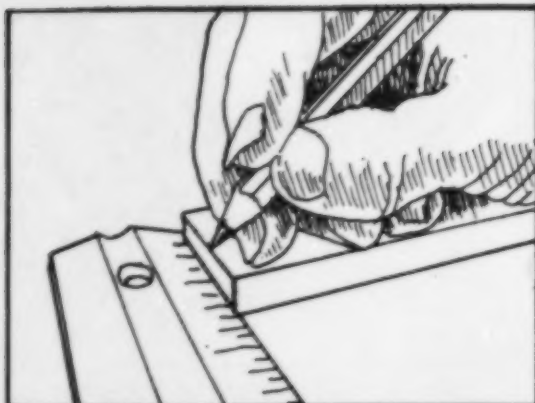
STEP 8 — Measure over 7/16 inch (1.11 cm) from the seventh mark and put the eighth mark.



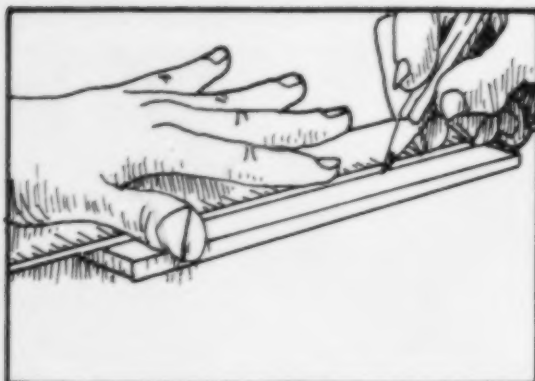
STEP 9 — Using the square, start at the first mark and scribe a line across the metal.



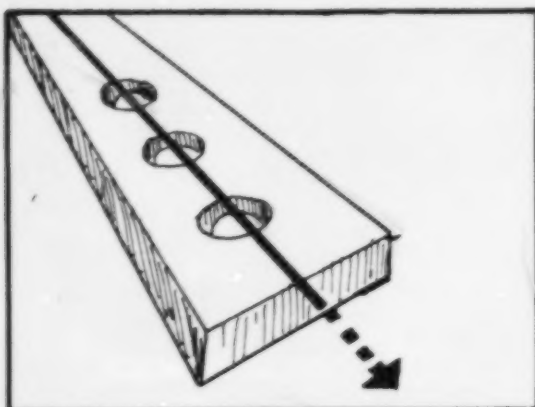
STEP 10 — Repeat step 9 on the remaining seven marks.



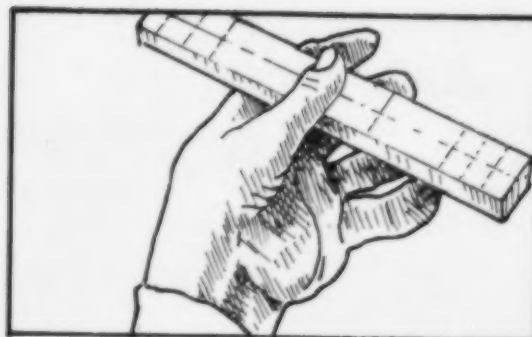
STEP 11 — Using the rule, measure and mark $\frac{3}{8}$ inch (.96 cm) on each end of the metal to locate the center.



STEP 12 — Using the ruler for a straight edge, scribe a mark from one center mark to the other.



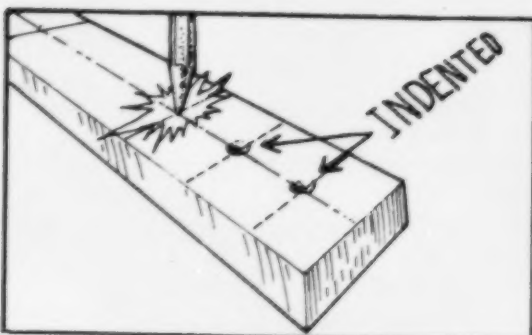
STEP 13 — Where the center line crosses the previously drawn lines will locate the center of all eight holes on the piece of metal.



STEP 14 — Repeat steps 1–13 on the second piece of metal.



STEP 15 — Pick up the ball peen hammer and center punch. Punch the metal where the lines cross.



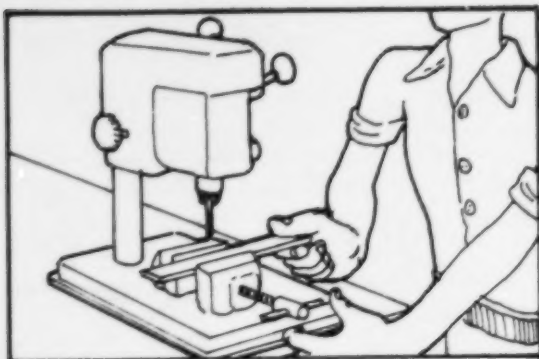
STEP 16 — Pick up the second piece of metal and repeat step 15.

Check Point

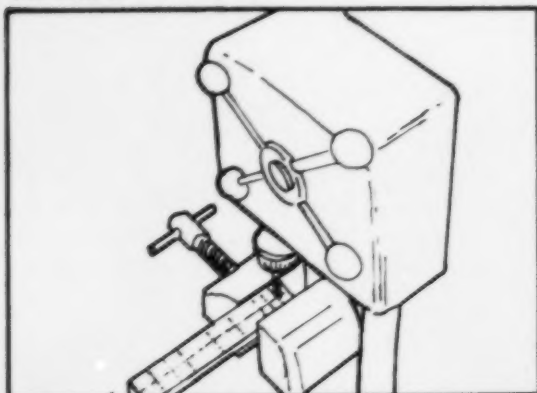
Are all the holes even on both pieces of metal and are they spaced correctly? If so, proceed to the next instructional objective. If not, repeat the last objective on the unmarked side of the metal.

Instructional Objective XI

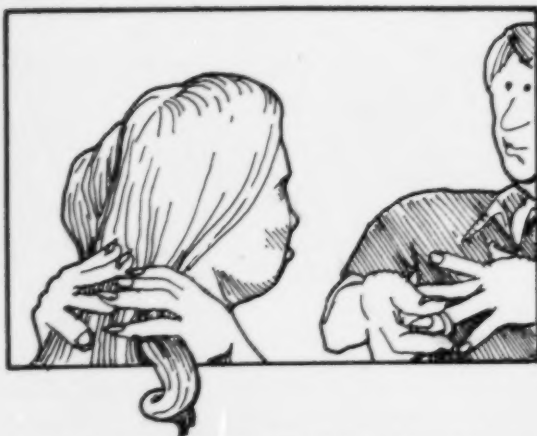
The student will drill eight 1/4 inch (.64 cm) holes in both pieces of metal.



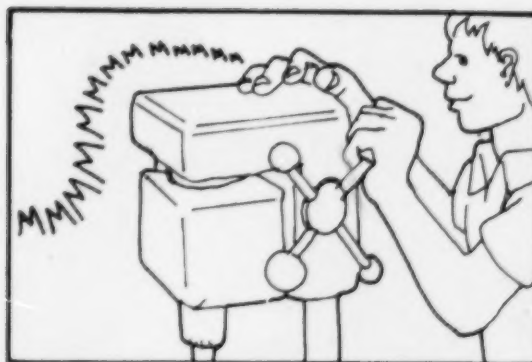
STEP 1 – Put one of the pieces of metal in the vise on the drill press with the marks up.



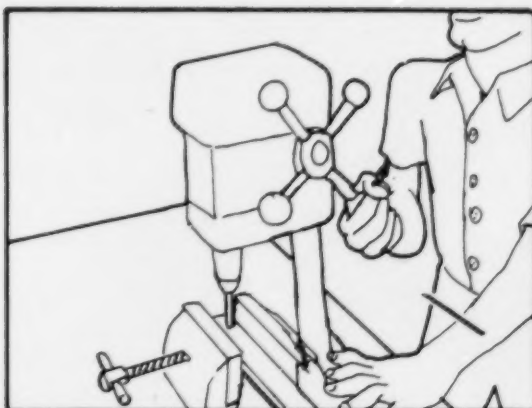
STEP 2 – Using the mark closest to the end of the metal, adjust the 1/4 inch drill bit to the punch mark.



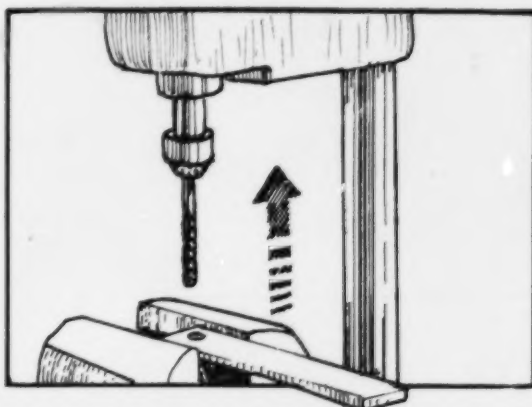
STEP 3 – Remember all safety rules which go along with the drill press. Review objectives if needed.



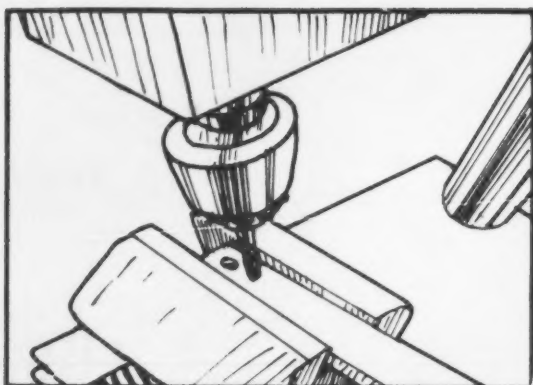
STEP 4 – Grasp the handle of drill press; turn on drill.



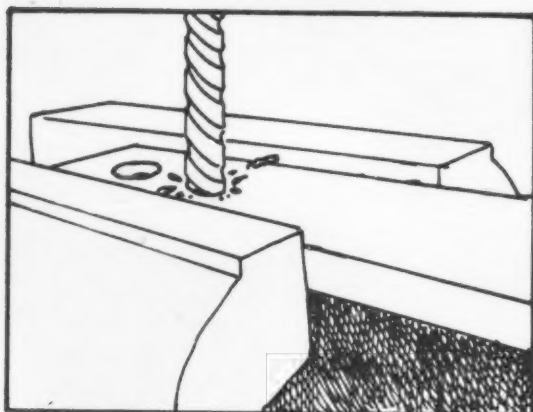
STEP 5 – Drill a hole through the metal by pulling down on the arm of drill press.



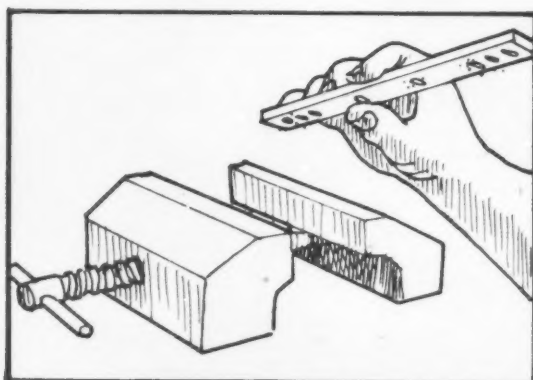
STEP 6 – When the drill bit has gone through the metal, let the drill handle back up slowly and turn off machine.



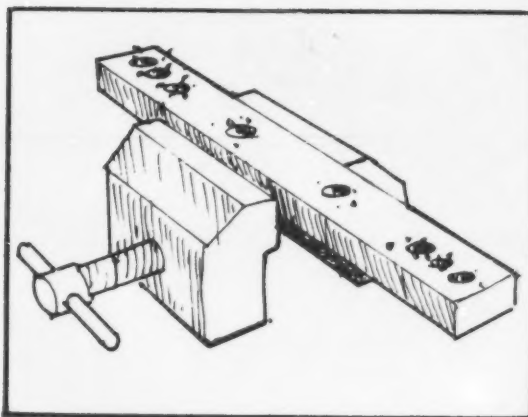
STEP 7 — Adjust the vise so the second punch mark and the point of the 1/4 inch drill bit line up.



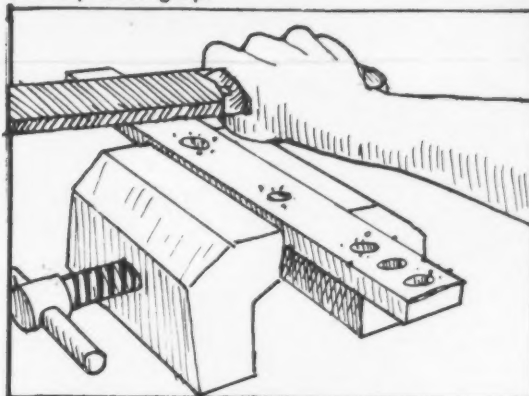
STEP 8 — Repeat steps 4, 5, and 6 then adjust vise so that the third punch mark and the point of the 1/4 inch drill bit line up. Repeat this operation for all eight holes.



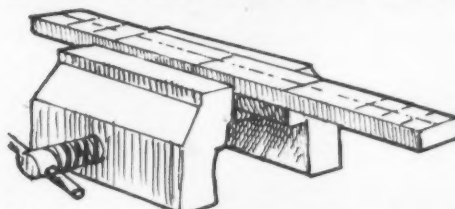
STEP 9 — Remove metal from vise and turn the metal over. Observe burrs on bottom of each hole.



STEP 10 — Put the metal in the vise with burrs pointing up.



STEP 11 — Using the file, remove the burrs.



STEP 12 — Put the second piece of metal in the vise on the drill press, with the marks pointing up.

Repeat Repeat Repeat Repeat Repeat
Repeat Repeat Repeat Repeat Repeat
Repeat Repeat Repeat Repeat Repeat

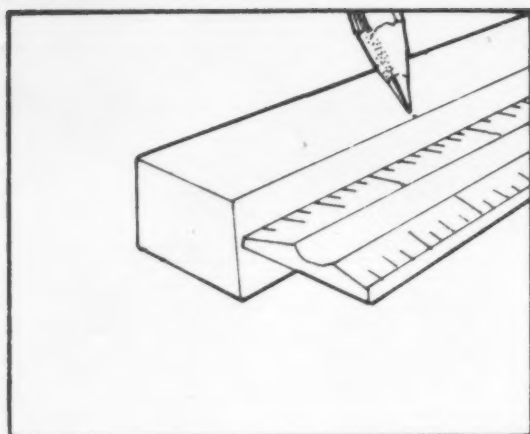
STEP 13 — Repeat steps 2 — 11.

Check Point ✓

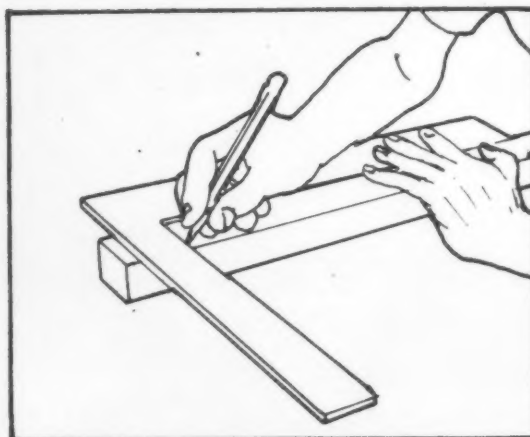
Are all the drilled holes free of burrs? If they are, proceed to the next instructional objective.

Instructional Objective XII

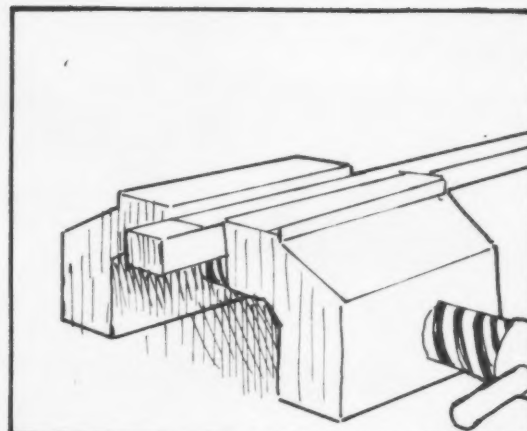
The student will measure and cut stock for center block of the puller.



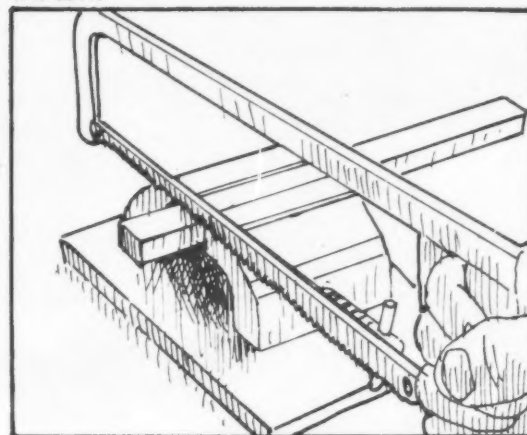
STEP 1 — Using the ruler, measure a piece of $\frac{3}{4} \times \frac{3}{4}$ inch square stock $1\frac{5}{8}$ inches long and mark it.



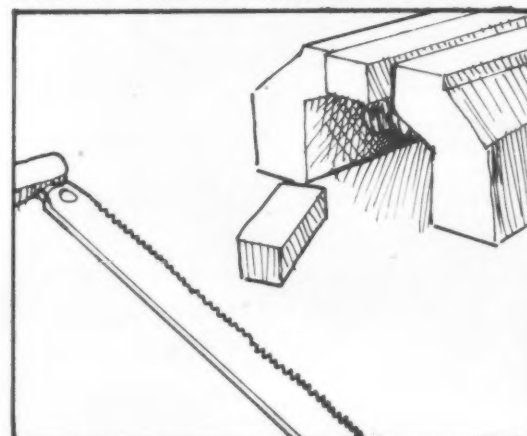
STEP 2 — Using the square, mark the metal at $1\frac{5}{8}$ inch measurement and scribe a line across the metal.



STEP 3 — Clamp the metal in the vise with the line on top. Locate the line as close to the vise as possible without cutting the vise with the saw.



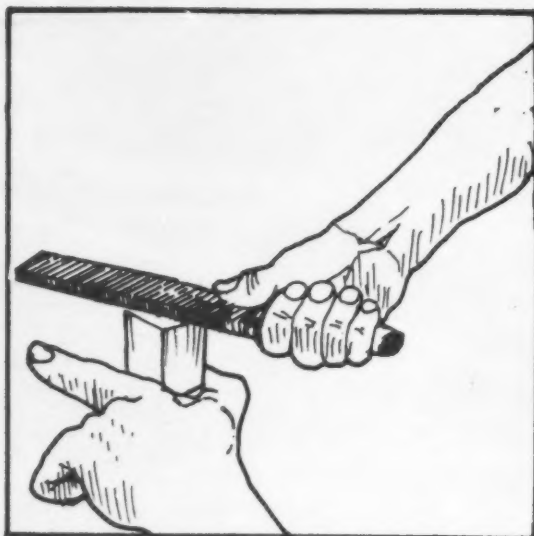
STEP 4 — Place the hacksaw on the mark.



STEP 5 — Cut the metal using even strokes. Lay the saw down on its side when the metal has been completely cut.

Instructional Objective XIII

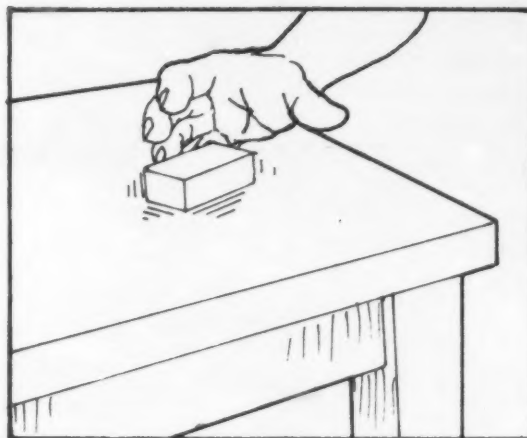
Using layout tools, each student will measure and mark the holes located on the center block.



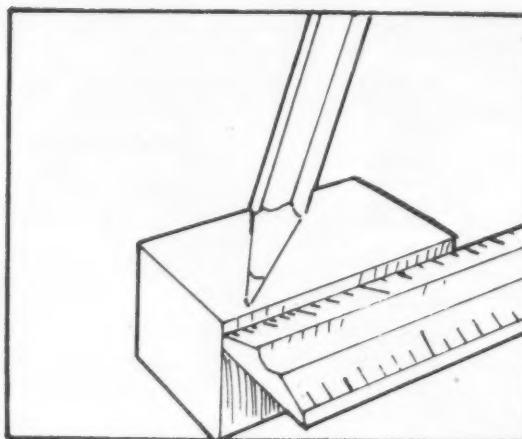
STEP 6 — Using a file, file the cut ends of metal smooth and flat.

Check Point

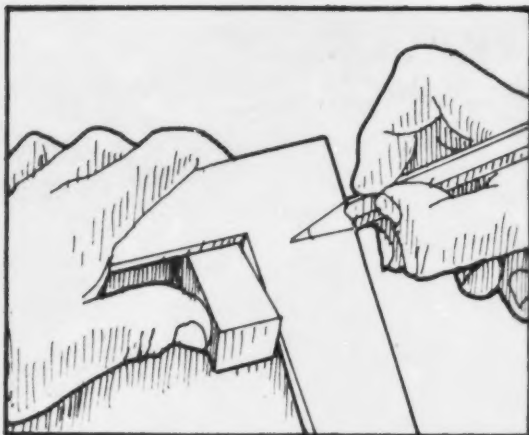
Check each end of the metal with a square. If the metal is not square put the metal back in the vise with the end sticking up about 1/2 inch (1.57 cm) above the vise.



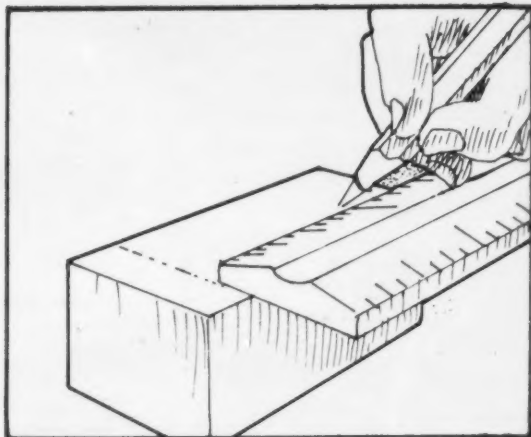
STEP 1 — Place the metal on the table.



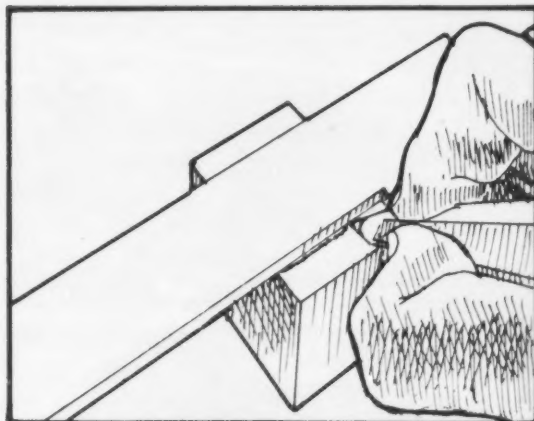
STEP 2 — Pick up the metal ruler and measure in 5/16 inch from one end and put a mark.



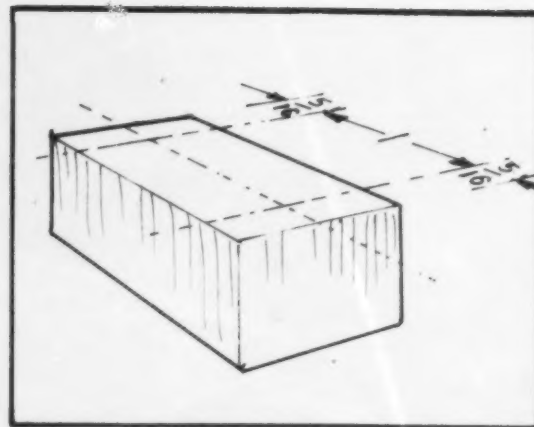
STEP 3 — Using the square, scribe a mark across the metal at the point.



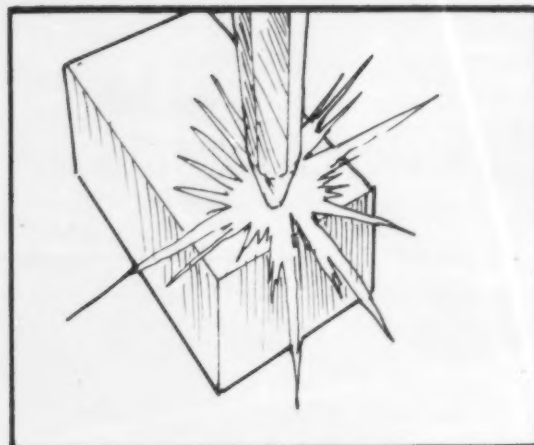
STEP 4 — Using the ruler, measure over 1 inch (2.54 cm) from the first mark and make a mark.



STEP 5 — Using the square, scribe a mark across the metal.



STEP 6 — Measure up each side $\frac{3}{8}$ inch and place a mark. This locates the center of the metal. Scribe a line between these two points.



STEP 7 — Obtain a ball peen hammer and center punch. Punch the metal where these lines cross. This locates the centers of the two holes.

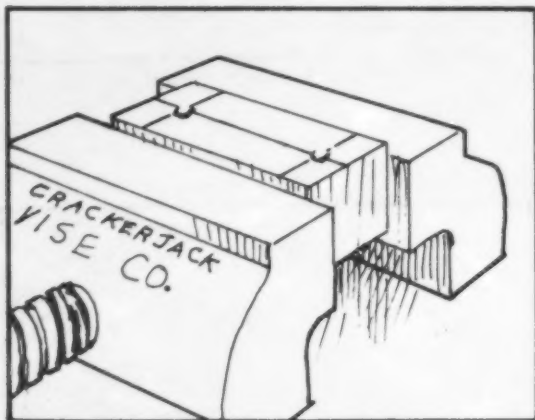
Check Point

Are the holes even and located in the correct place?

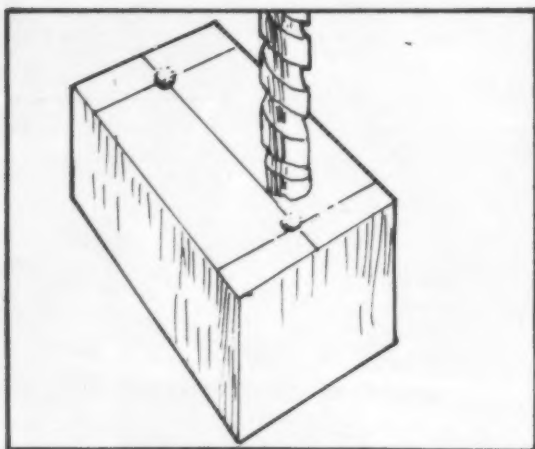
If they are, proceed to the next instructional objective. If not, repeat the last objective.

Instructional Objective ^{XIV}

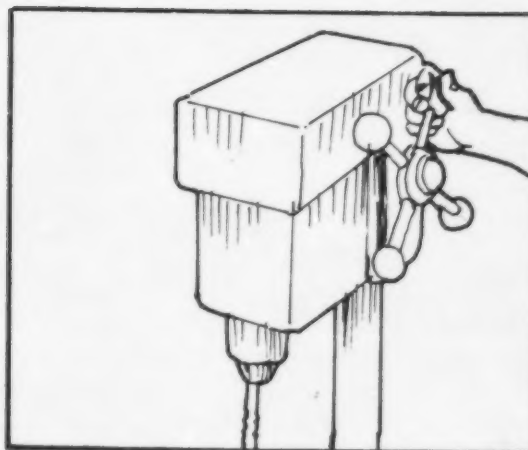
Each student will drill two 1/4 inch holes in the center block of metal.



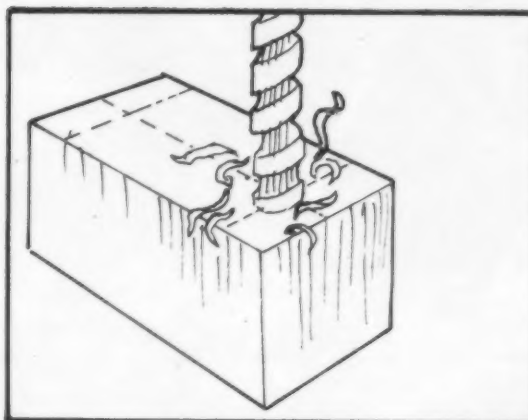
STEP 1 — Clamp the center block in the vise of the drill press. The punched marks should be facing the drill bit.



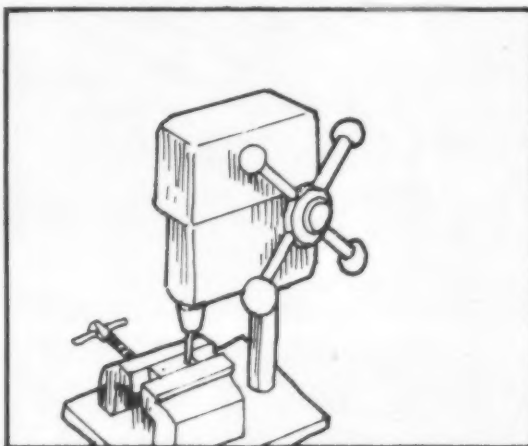
STEP 2 — Adjust the point of the 1/4 inch drill bit in one of the punch marks.



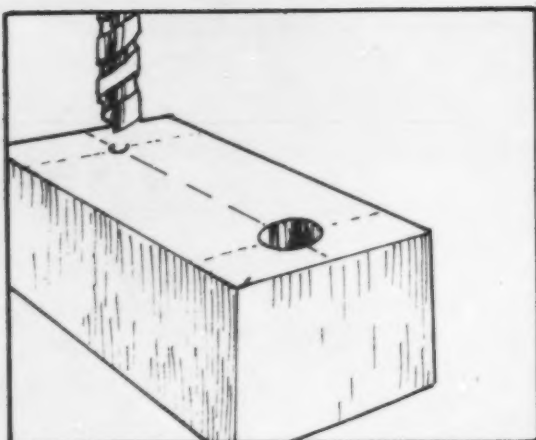
STEP 3 — Grasp the handle of the drill press and turn on the drill.



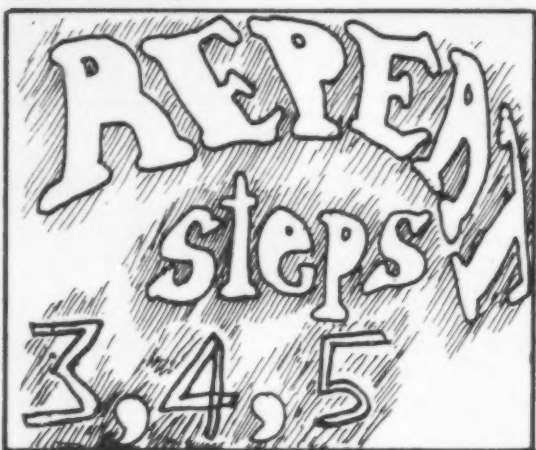
STEP 4 — Drill a hole through the metal by pulling down on the handle of the drill press.



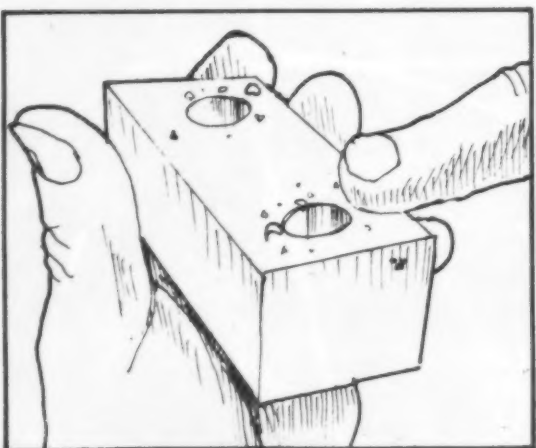
STEP 5 — After the hole has been drilled, let the drill handle up slowly and turn off machine.



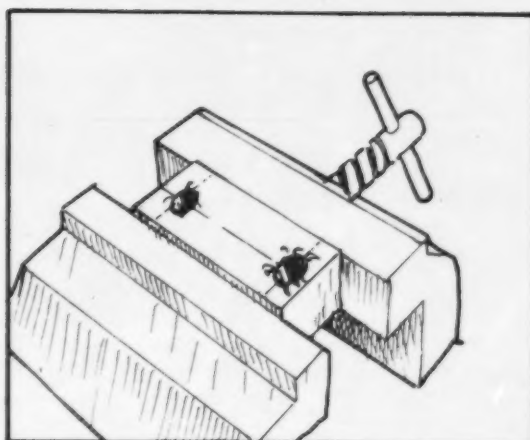
STEP 6 — Adjust the vise so that the other punch mark and the point of the 1/4 inch drill bit lines up.



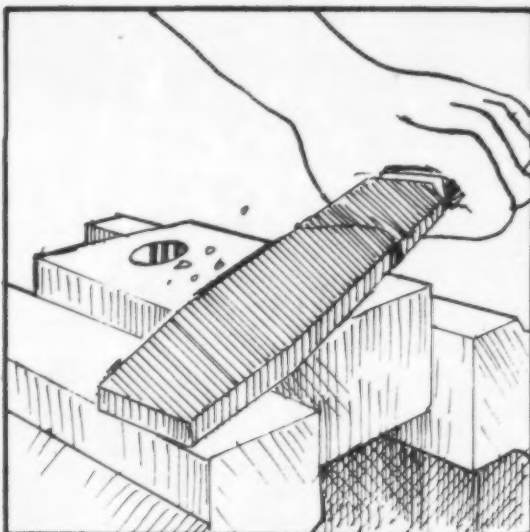
STEP 7 — Drill the second hole by repeating steps 3, 4, and 5.



STEP 8 — Remove the metal from the vise. Identify burrs on bottom of each hole; these must be cleaned.



STEP 9 — Put the center block in vise with the burrs up.



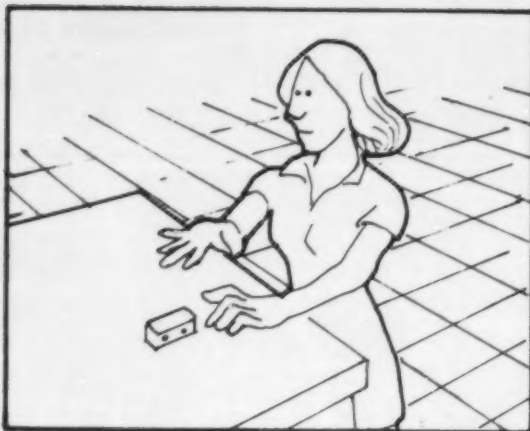
STEP 10 — Using the file, remove the burrs with long even filing strokes.

Check Point

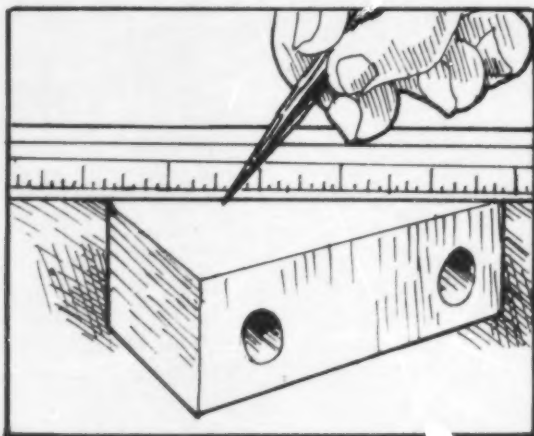
Are all the drilled holes free of burrs? If they are, proceed to the next instructional objective.

Instructional Objective XV

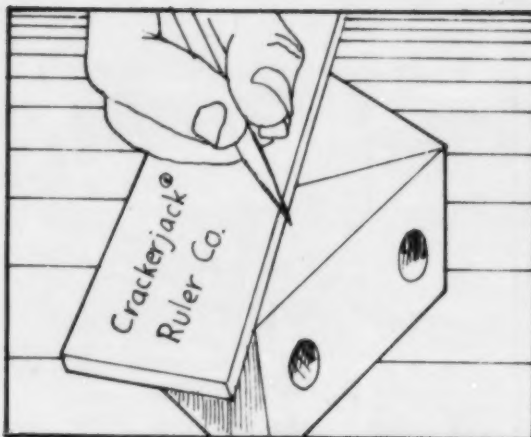
Using the center block ($\frac{3}{4} \times \frac{3}{4} \times 1\frac{5}{8}$ inch) of metal, each student will drill and tap a $\frac{3}{8}$ UNF hole through the center of the metal block.



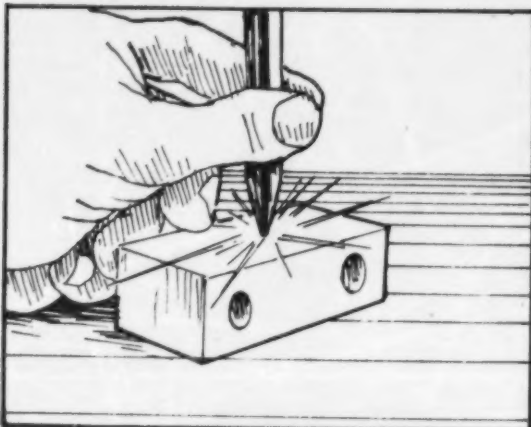
STEP 1 – Lay the metal on the table with the holes on the sides.



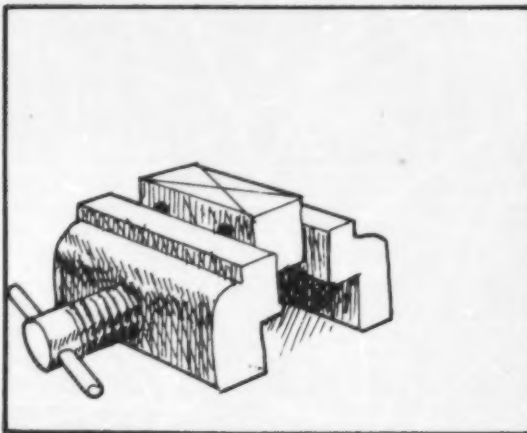
STEP 2 – Using the metal ruler, place it on two opposite corners (diagonals) of the metal. Scribe a mark from corner to corner.



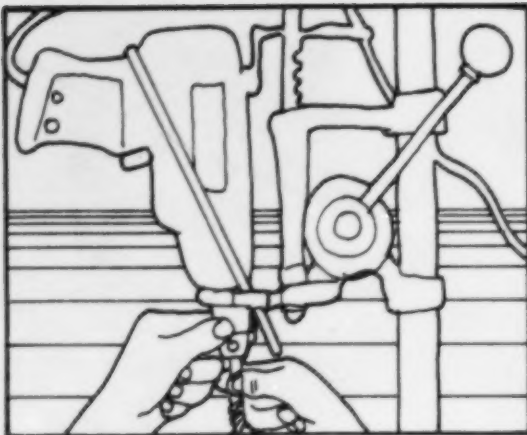
STEP 3 – Reverse the position of the metal ruler so that it crosses the other two corners and mark it with scribe.



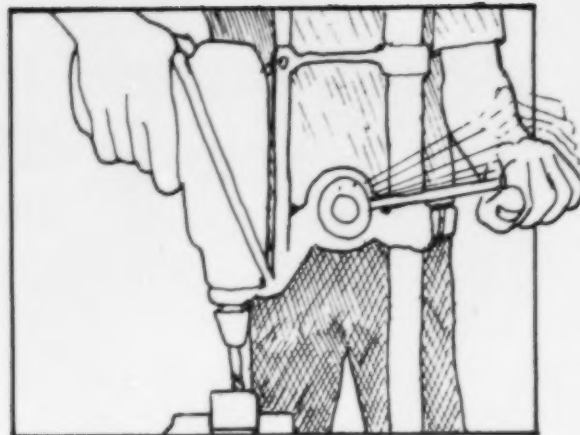
STEP 4 – Pick up the ball peen hammer and center punch. Punch the metal where the diagonal lines cross. This locates the center of the metal where the $\frac{3}{8}$ UNF hole will be drilled.



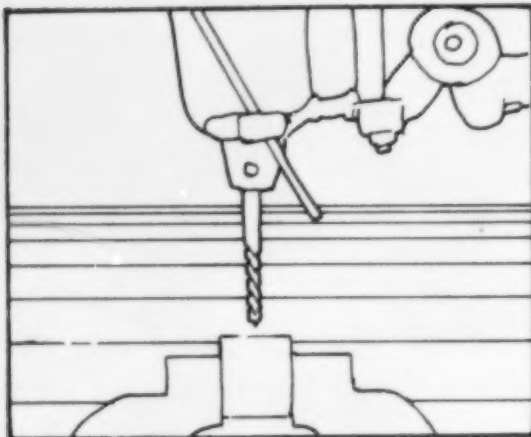
STEP 5 – Clamp the metal in the vise on the drill press with the center punch mark up.



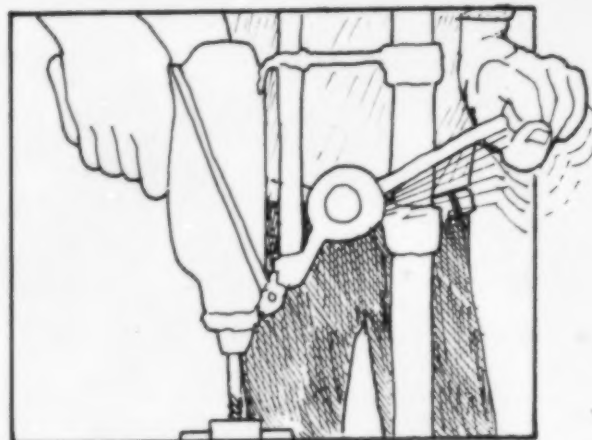
STEP 6 – Tighten the 21/64 inch drill bit in the drill.



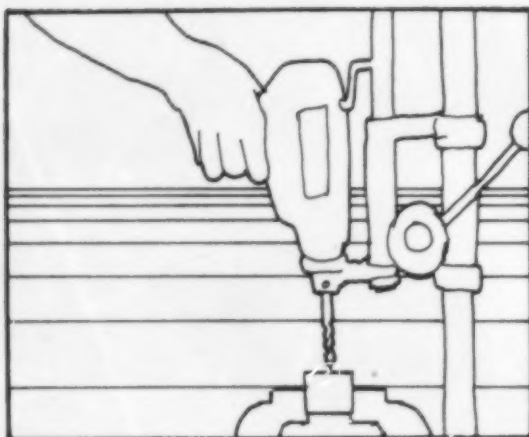
STEP 9 – Drill a hole through the metal by pulling down on the handle of the drill press.



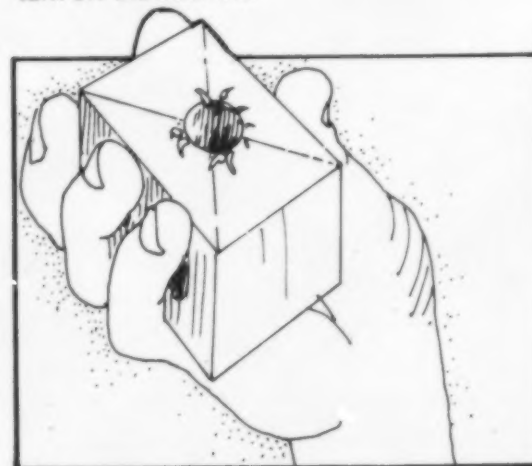
STEP 7 – Align the point of the 21/64 inch drill bit and the center punch mark.



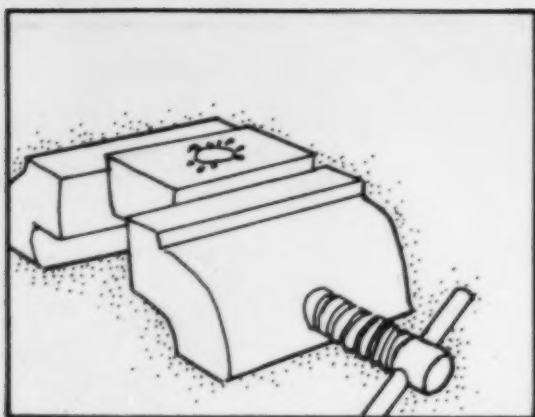
STEP 10 – Let the drill handle up slowly and turn off the machine.



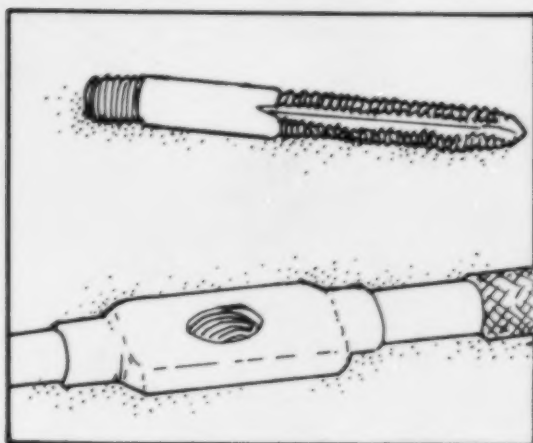
STEP 8 – Grasp the handle of the drill press and turn on the drill.



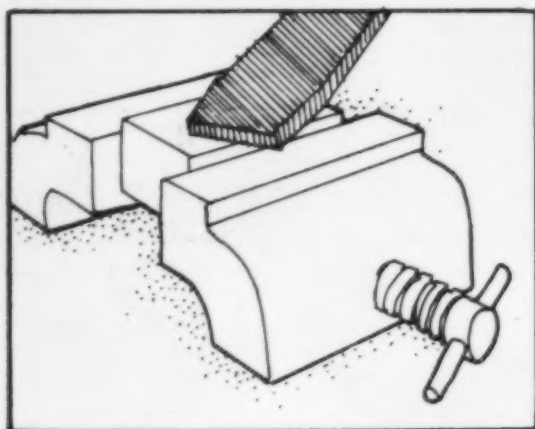
STEP 11 – Remove the metal from the vise and turn the metal over. Observe burrs on bottom of hole.



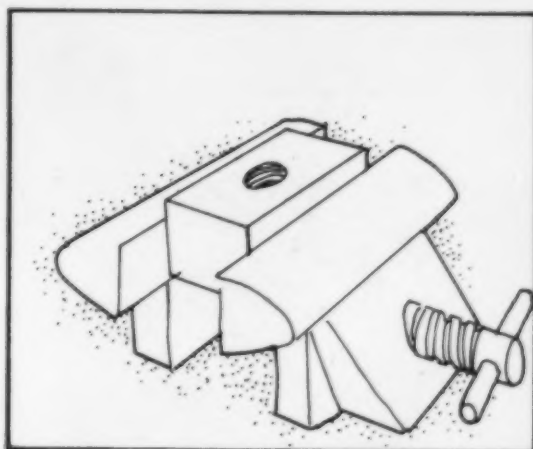
STEP 12 — Clamp the metal in vise with the burrs up.



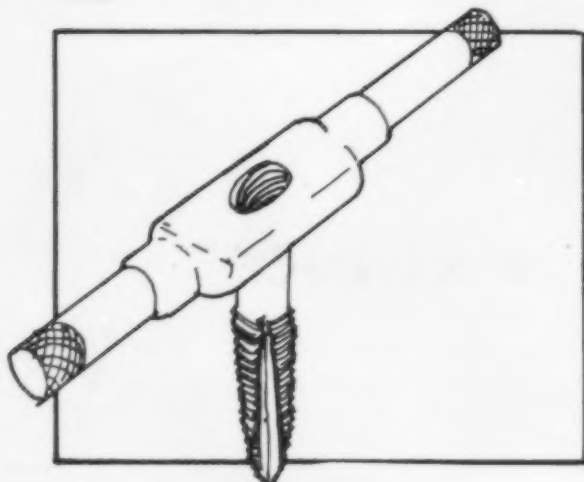
STEP 15 — Place the tap in the handle.



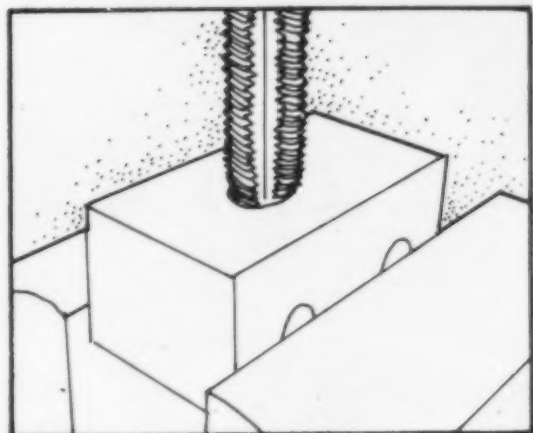
STEP 13 — Using the file, remove all the burrs.



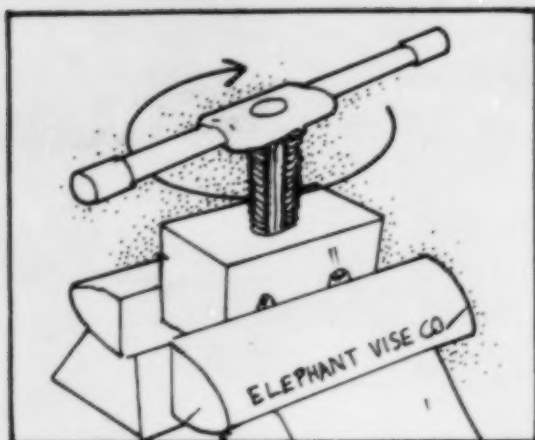
STEP 16 — Clamp the metal in the vise with the hole up.



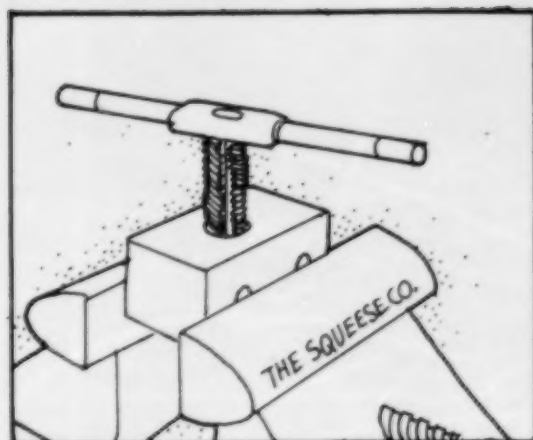
STEP 14 — Obtain the 3/8 UNF tap and handle.



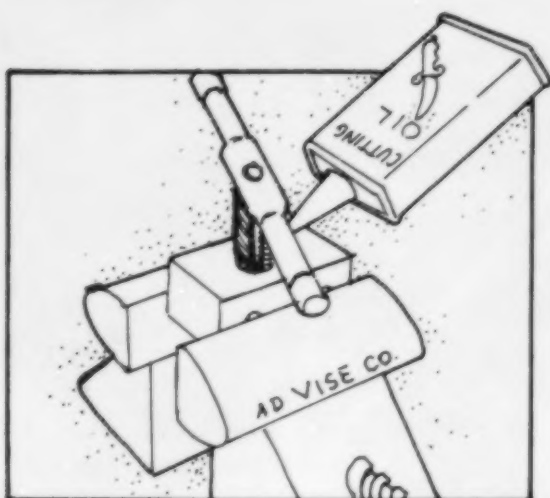
STEP 17 — Set point of tap in the 21/64 inch hole.



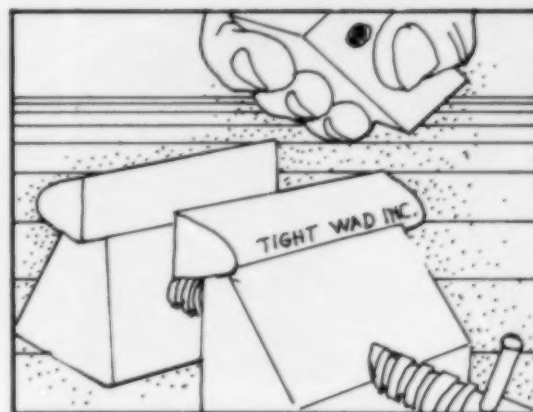
STEP 18 — Start the tap by making short, vertical turns.



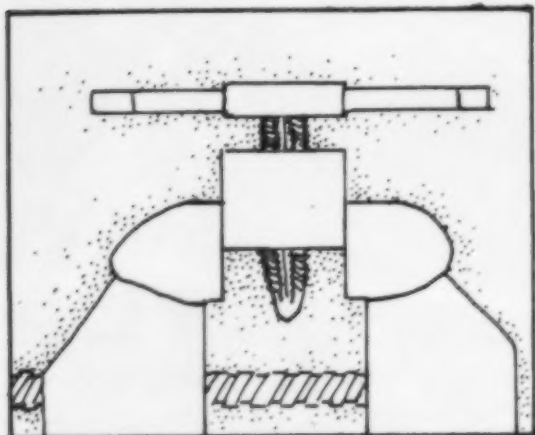
STEP 21 — Remove the tap from the hole.



STEP 19 — Every full turn with the tap requires one-half turn backwards. Add a drop of cutting oil every third turn.



STEP 22 — Remove the metal from the vise.



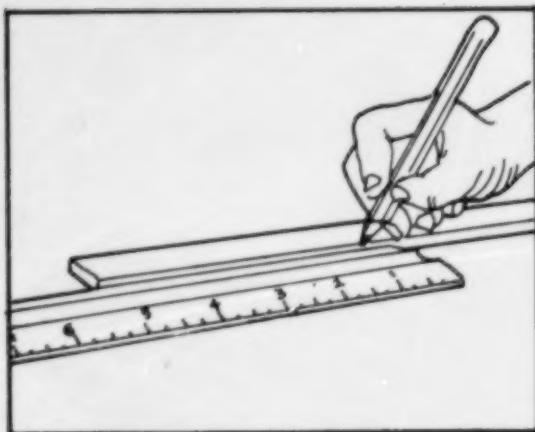
STEP 20 — Continue turning the tap into the hole until the threads are all through.

Check Point

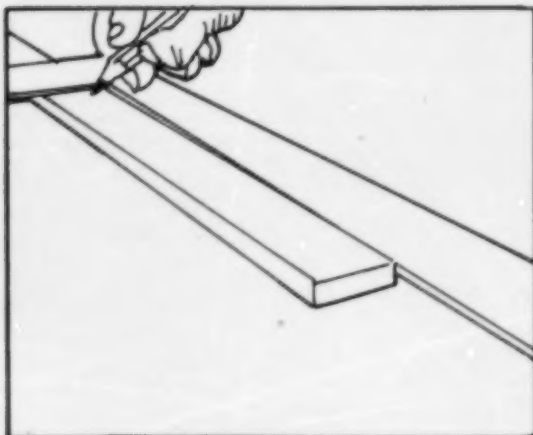
Make sure the threads are neat and clean.
Remove all excess metal.

Instructional Objective XVI

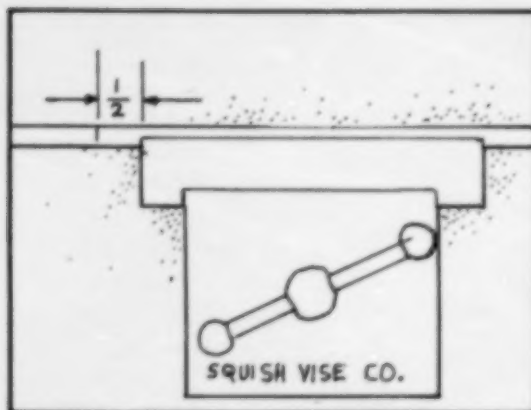
Given the proper tools, each student will measure and cut two pieces of $\frac{1}{4} \times \frac{3}{4}$ inch flat stock. These will be used for the hooks of the gear puller.



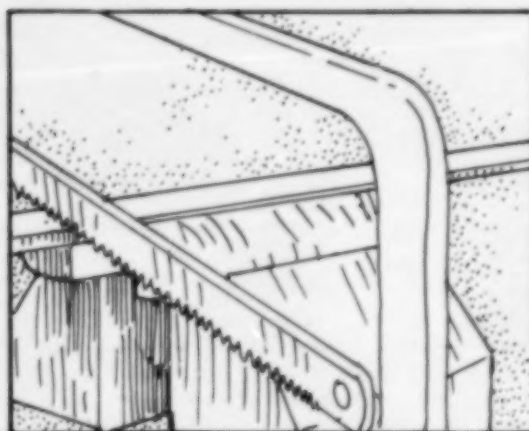
STEP 1 — Using the ruler, measure and mark a piece of $\frac{1}{4} \times \frac{3}{4}$ inch flat stock 5 inches (12.70 cm) long.



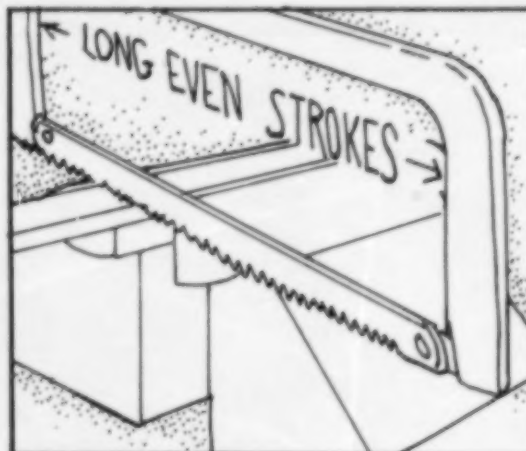
STEP 2 — Using the square, scribe a line across the metal at the 5 inch (12.70 cm) mark.



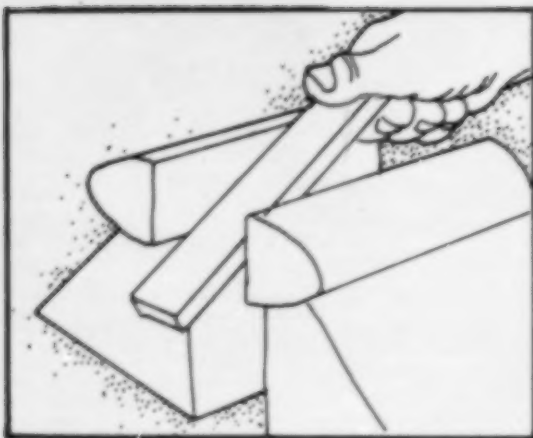
STEP 3 — Clamp the metal in the vise with the line about $\frac{1}{2}$ inch (1.27 cm) from the jaws.



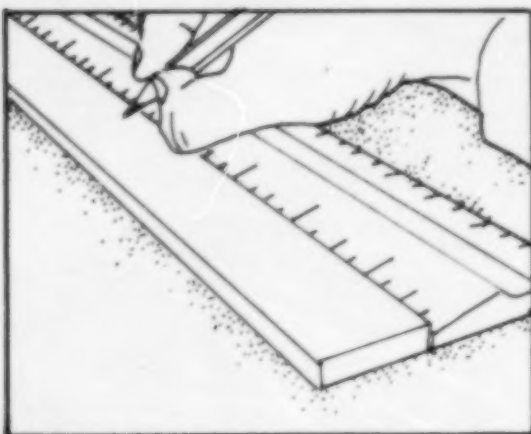
STEP 4 — Place the hacksaw on the mark.



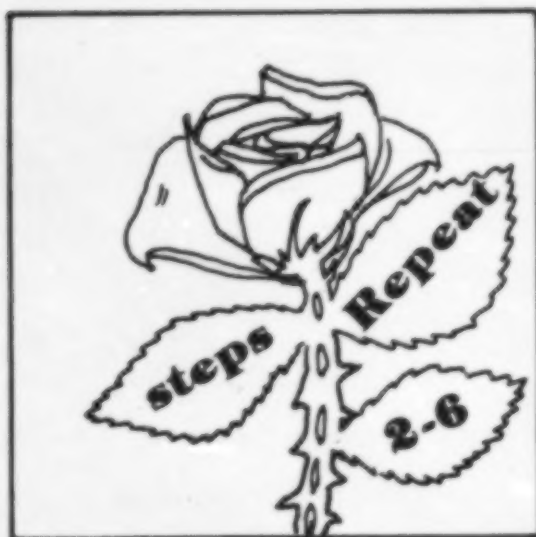
STEP 5 — Cut the metal using long and even strokes. Lay the saw down on its side.



STEP 6 — Remove the metal from the vise.



STEP 7 — Mark another piece of $\frac{1}{4} \times \frac{3}{4}$ inch flat metal stock 5 inches (12.70 cm) long.



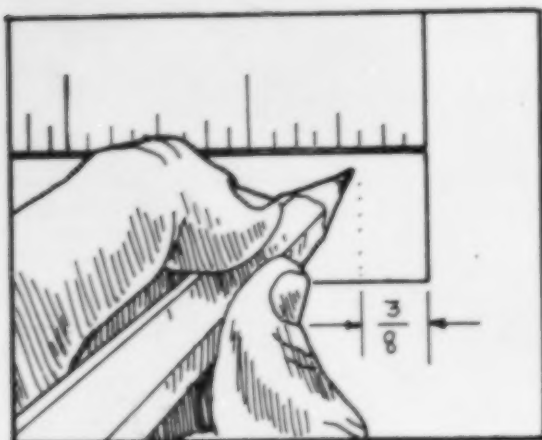
STEP 8 — Repeat steps 2 — 6.

Check Point

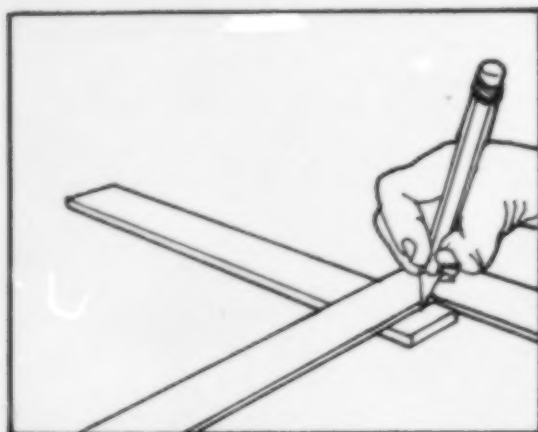
Check each end of the metal with a square. If the metal is not square, put it back in the vise with the end about $\frac{1}{2}$ inch (1.27 cm) above the vise and file the end square.

Instructional Objective XVII

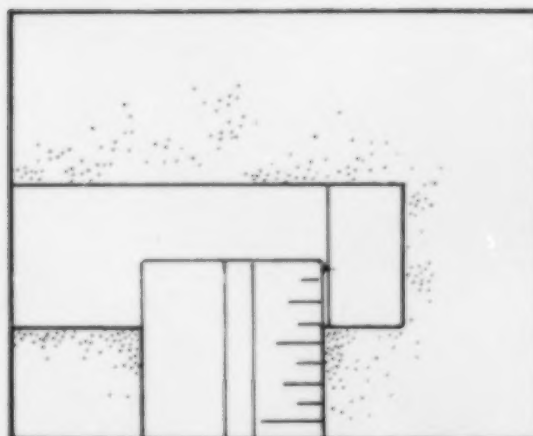
The student will measure, mark and drill 1/4 inch holes in each hook of the gear puller.



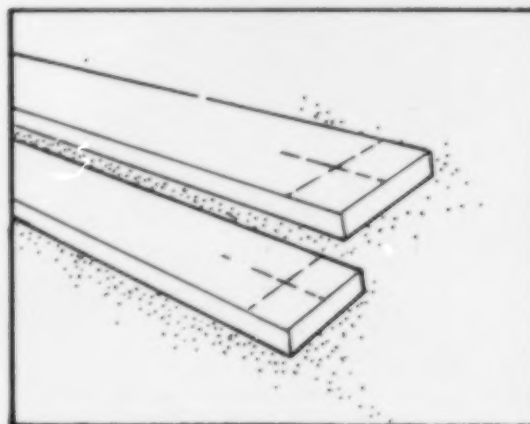
STEP 1 – Pick up one hook and measure one end 3/8 inch and mark it. 4



STEP 2 – Scribe a line across the mark.



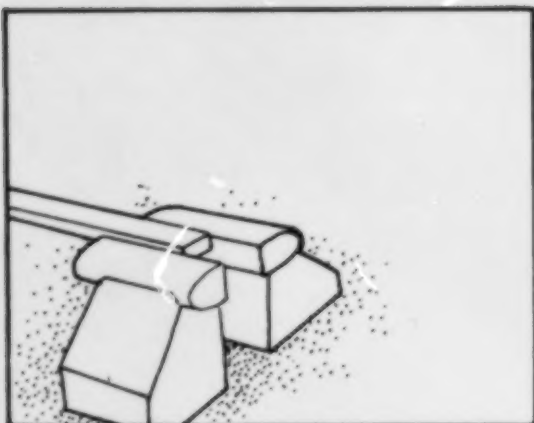
STEP 3 – On the same line, measure across 3/8 inch and mark it; this will locate the center of a 1/4 inch hole.



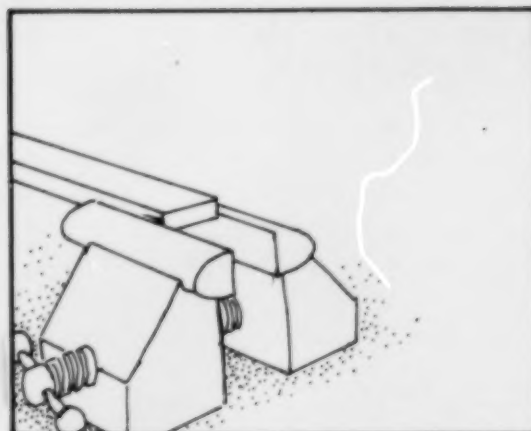
STEP 4 – Repeat steps 1 – 3 on the second piece of metal.



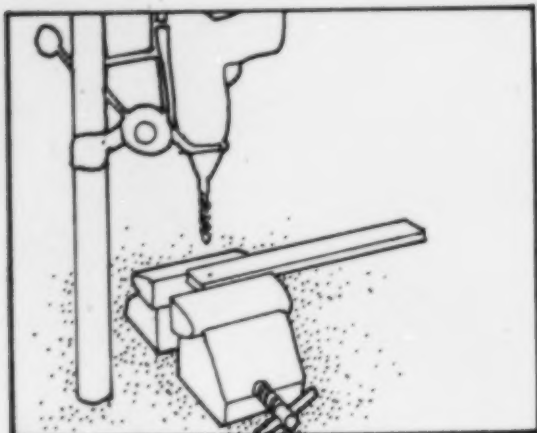
STEP 5 – Pick up the ball peen hammer and center punch. Punch the two pieces of metal where these marks cross. This locates the center of the two 1/4 inch holes.



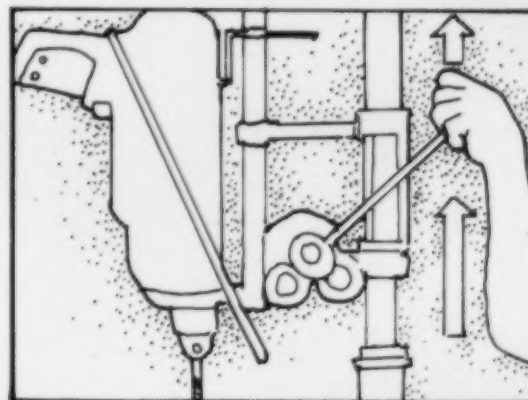
STEP 6 — Clamp one of the metal hooks in the vise on the drill press with the mark up.



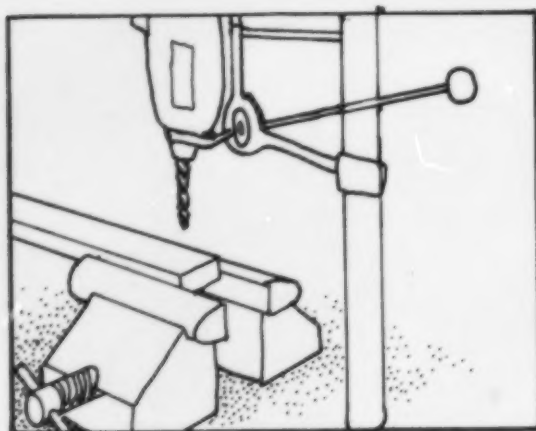
STEP 9 — Drill a hole through the metal by pulling down on the handle of the drill press.



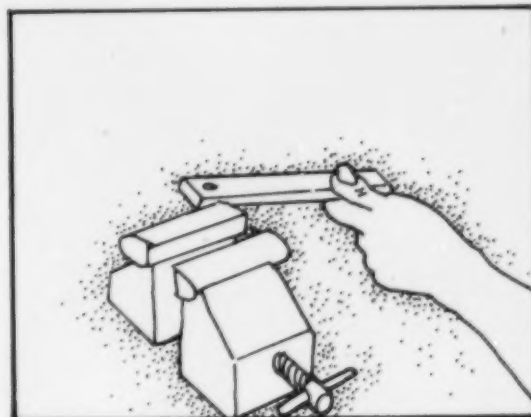
STEP 7 — Locate the point of the 1/4 inch drill bit over the punch mark.



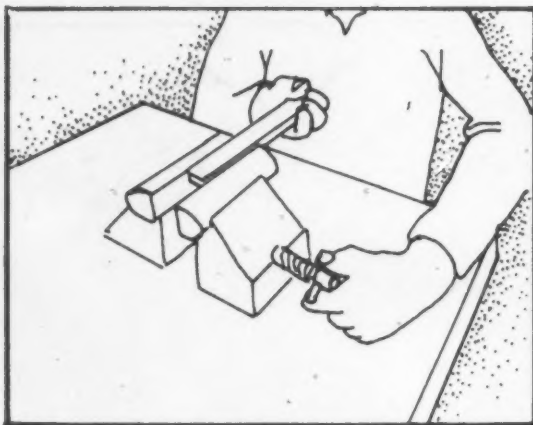
STEP 10 — Let drill handle up slowly and turn off the machine.



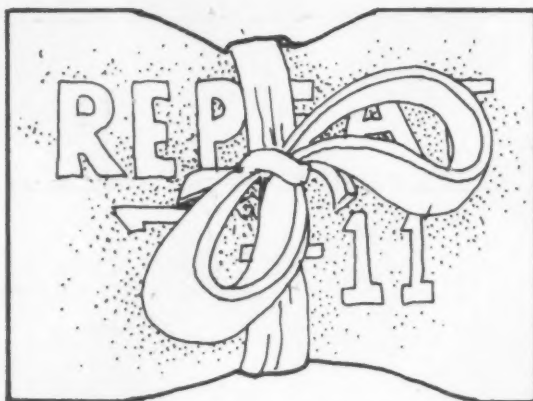
STEP 8 — Grasp the handle of the drill press and turn on the drill.



STEP 11 — Remove the metal from the vise.



STEP 12 — Clamp the second hook in the vise.



STEP 13 — Repeat steps 7 — 11.

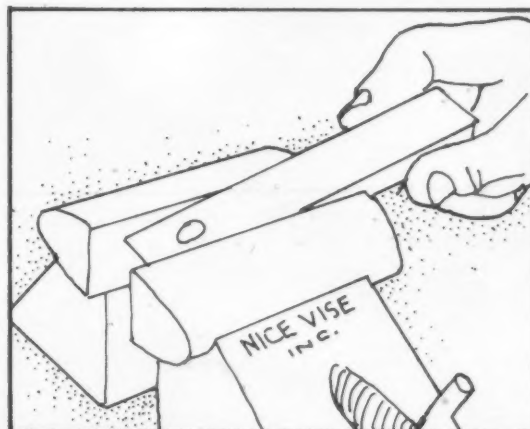


STEP 14 — Remove metal from vise and turn the hook over. Observe burrs on bottom of each hole, these must be removed.

STEP 15 — Clamp the hook in a vise with the burrs up.



STEP 16 — Using a file, remove all the burrs.



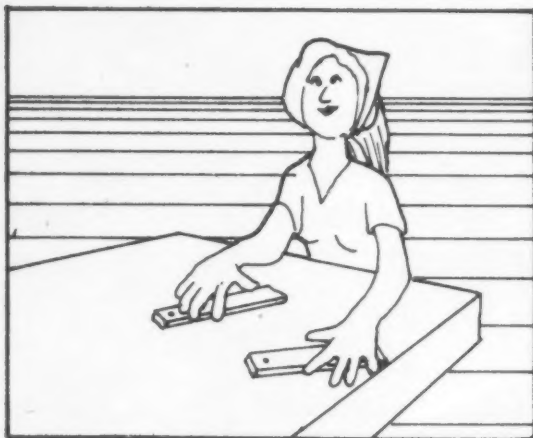
STEP 17 — Clamp the second hook in the vise and remove the burrs from it with the file.

Check Point

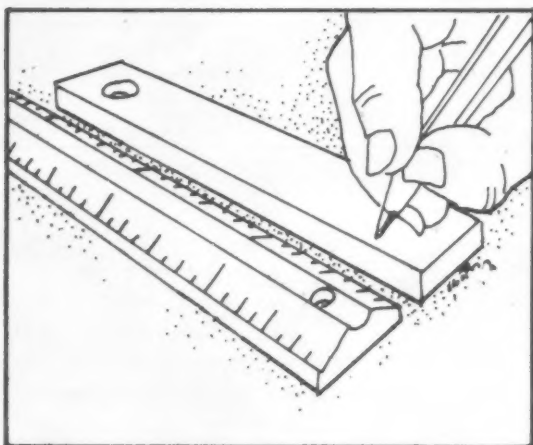
Are both hooks similar? Are all the burrs removed? If so, proceed to the next objective.

Instructional Objective^{xviii}

Using the proper tools, each student will lay out the hook shape for the gear puller. (refer to the working drawing handout)



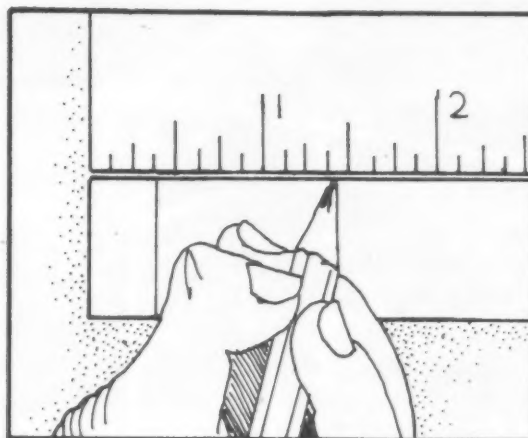
STEP 1 — Lay the two $\frac{1}{4} \times \frac{3}{4} \times 5$ inch pieces of metal flat on a table top.



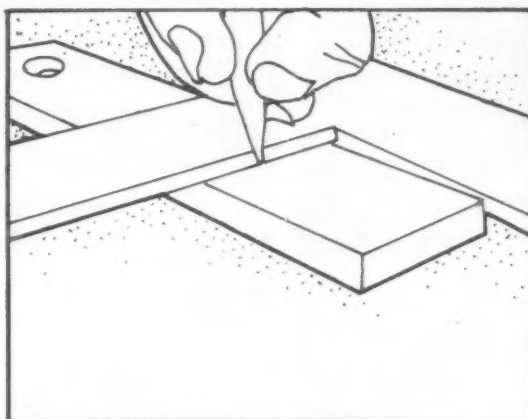
STEP 2 — Opposite from the drilled end of the hook, measure $\frac{3}{8}$ inch and make a mark.



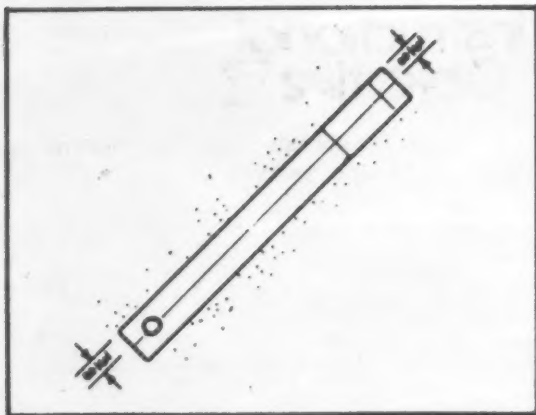
STEP 3 — Put a square on this mark and scribe a line across the metal.



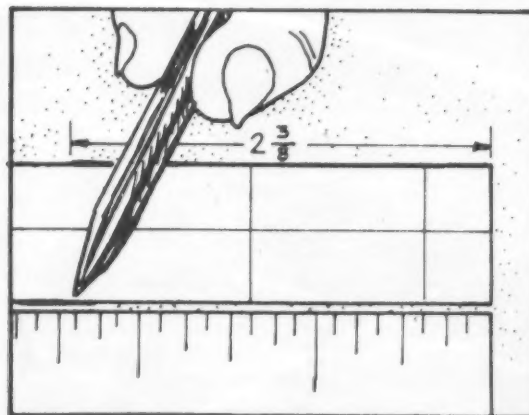
STEP 4 — Using the same end of the metal, measure $1\frac{3}{8}$ inch and make a mark.



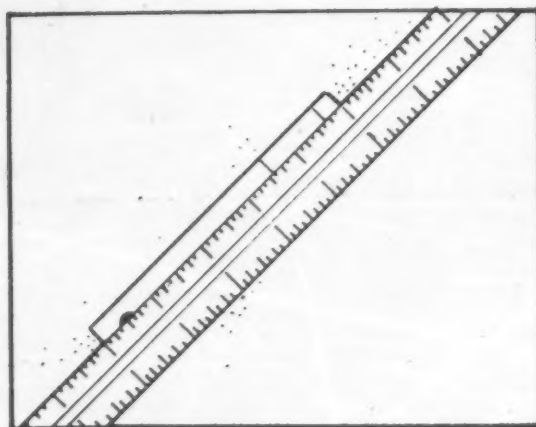
STEP 5 — Put a square on this mark and scribe a line across the metal.



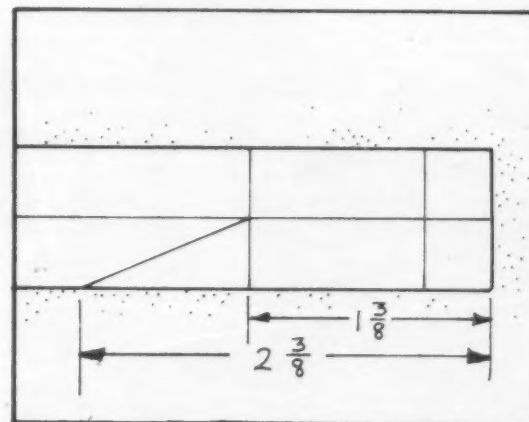
STEP 6 — Measure and mark $\frac{3}{8}$ inch on each end of the metal, this will locate the center of the metal hook.



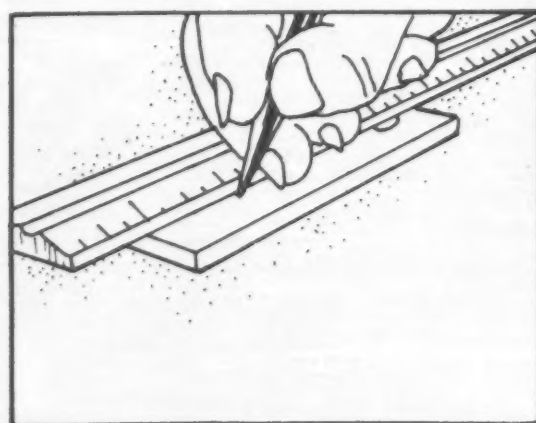
STEP 9 — Using the bottom end, measure and mark $2\frac{3}{8}$ inch.



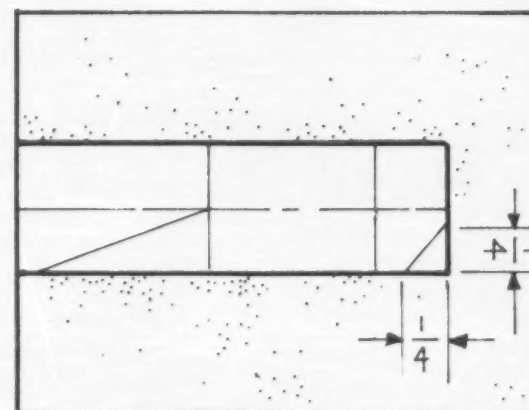
STEP 7 — Using the ruler, place the edge on the two $\frac{3}{8}$ inch points.



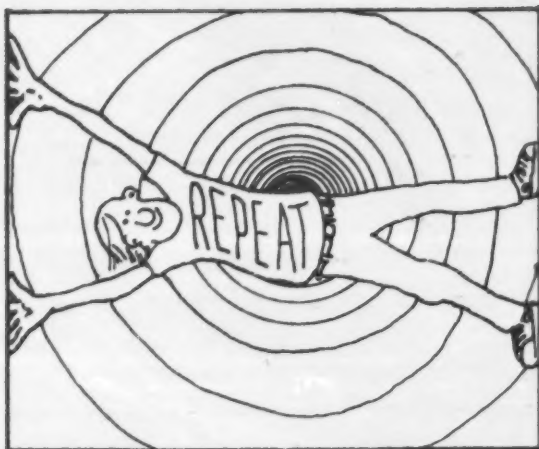
STEP 10 — Using the ruler as a straight edge, draw a line from the $2\frac{3}{8}$ inch mark to the center of the metal at a $1\frac{3}{8}$ inch line.



STEP 8 — Scribe a line from point to point.



STEP 11 — Measure and mark $\frac{1}{4}$ inch on both sides of the hook corner. (Refer to working drawing.) Scribe a diagonal line across this corner at these marks.



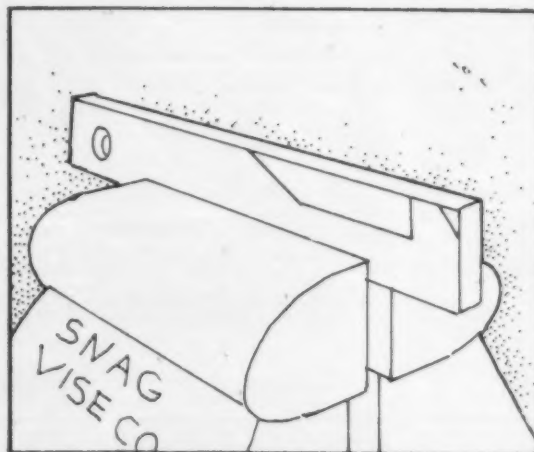
STEP 12 — Repeat steps 2 — 11 to the second hook.

Check Point

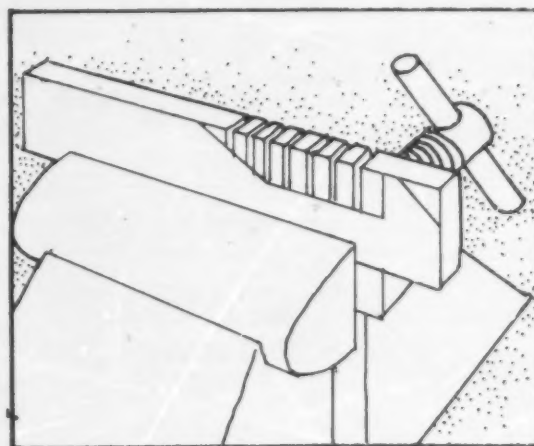
Ask another student to check all measurements. If they are correct, move on to the next objective.

Instructional Objective XIX

Given the correct tools, each student will form and file the hooks.



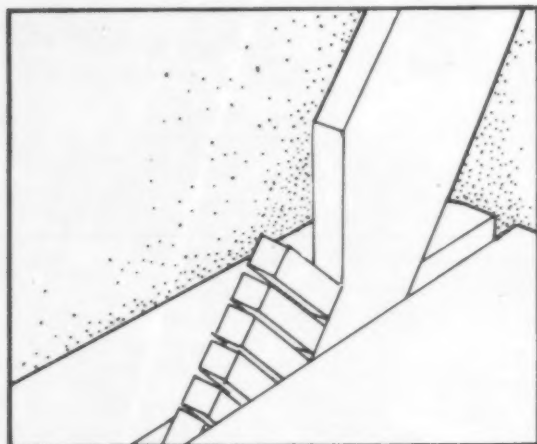
STEP 1 — Clamp a metal hook in a vise with the scribed lines up.



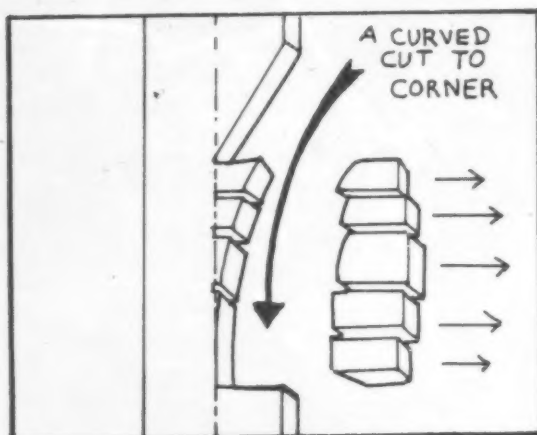
STEP 2 — Using the hacksaw, cut a series of relief cuts every 1/4 inch to the lines.



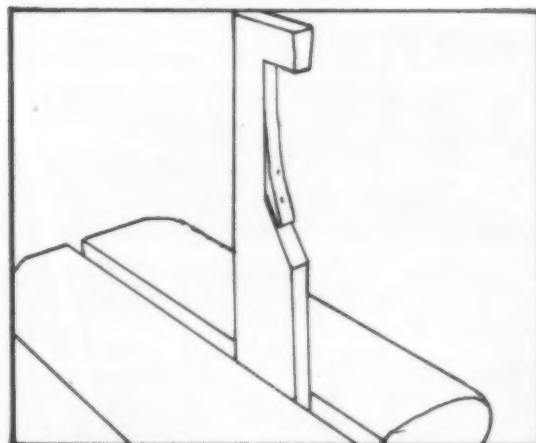
STEP 3 — Change the position of the hook so the diagonal line is vertical.



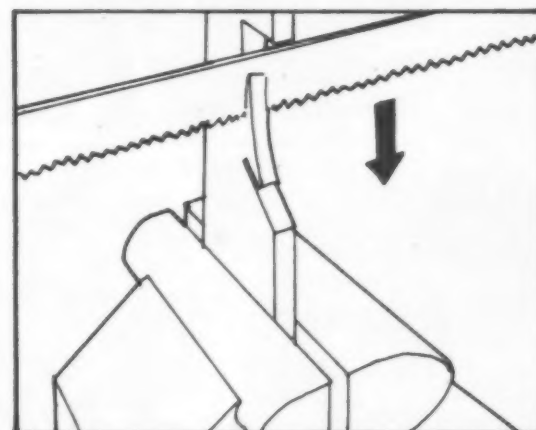
STEP 4 — Cut along the diagonal line until the end of the diagonal line is completely cut out.



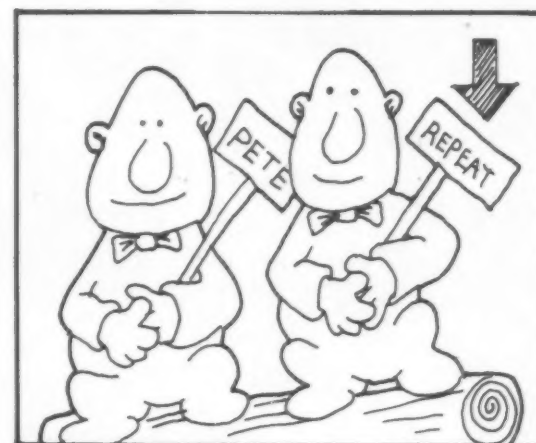
STEP 5 — Move the saw blade out 1/8 inch and begin cutting down gradually angling the cut to the center line. Saw down to the corner of the hook.



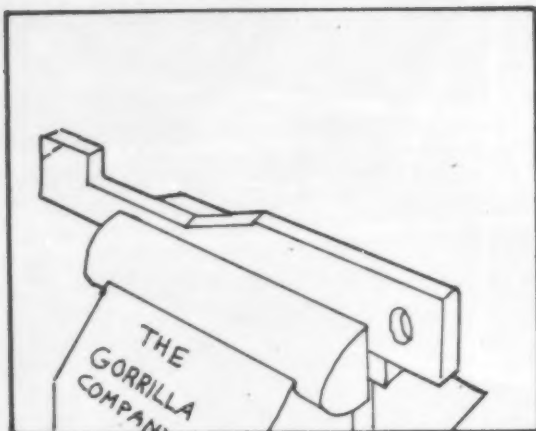
STEP 6 — Remove the hook from the vise, position it with the hole down.



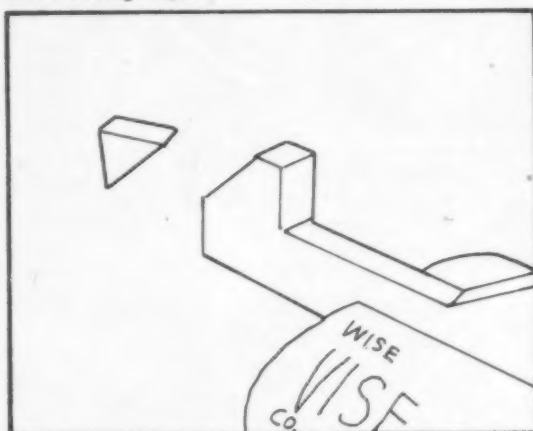
STEP 7 — Cut along the 3/8 inch line to the angle of the hook.



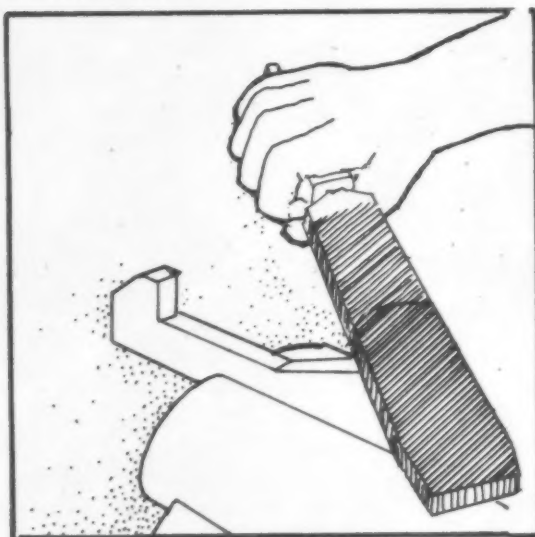
STEP 8 — Repeat steps 1 — 7 on the second metal hook.



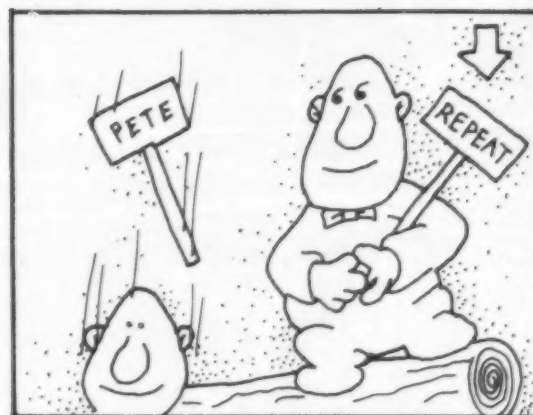
STEP 9 — Position the hook in the vise with the cut edge up.



STEP 10 — Cut the 1/4 x 1/4 inch corner off the end of the hook.



STEP 11 — File all the cut surfaces smooth.



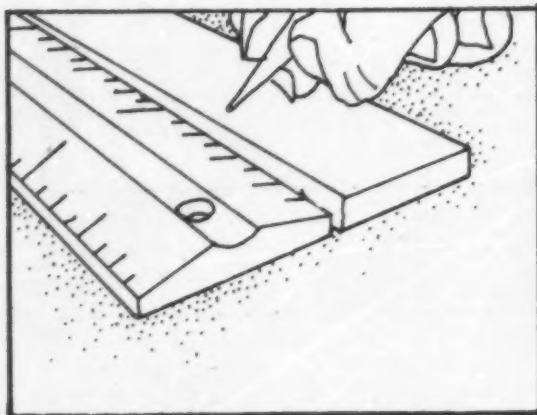
STEP 12 — Repeat steps 9 — 11 on the second piece of metal.

Check Point

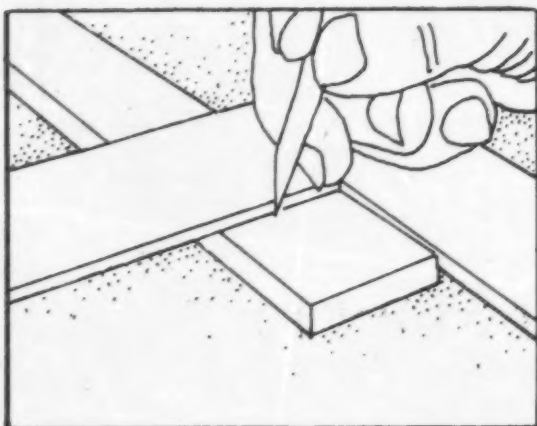
Are both hooks identical? Are the hooks free from metal burrs? If so, proceed to the next objective.

Instructional Objective XX

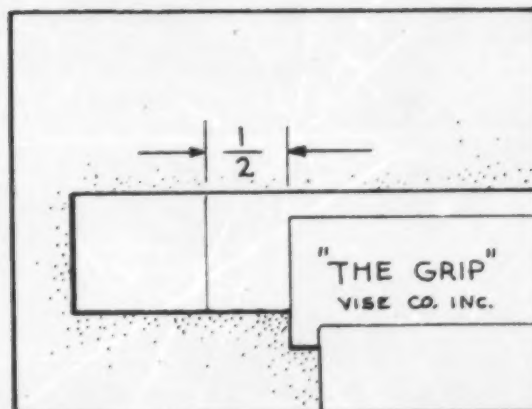
Given all tools and equipment, each student will cut and file four $\frac{3}{4} \times \frac{3}{4} \times \frac{1}{4}$ inch spacer blocks.



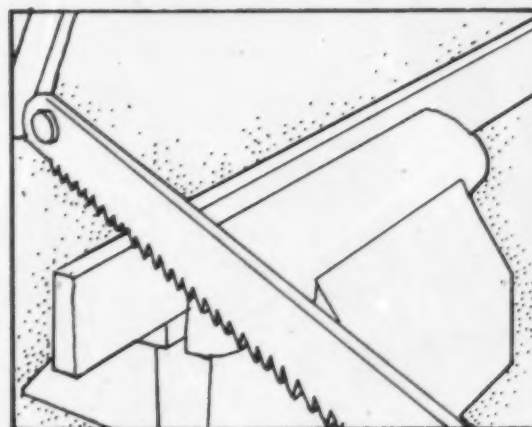
STEP 1 — Using a piece of $\frac{3}{4} \times \frac{1}{4}$ inch stock, measure and mark $\frac{3}{4}$ inch.



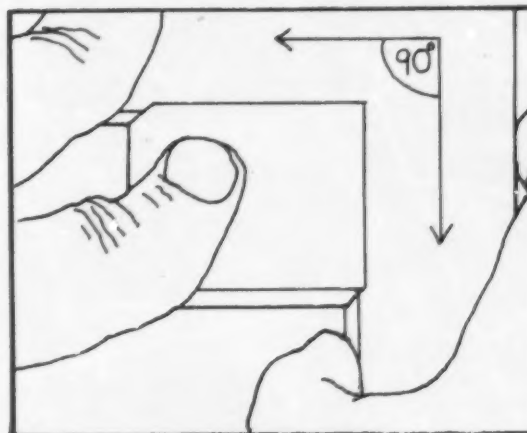
STEP 2 — Using a square, scribe a line across the metal.



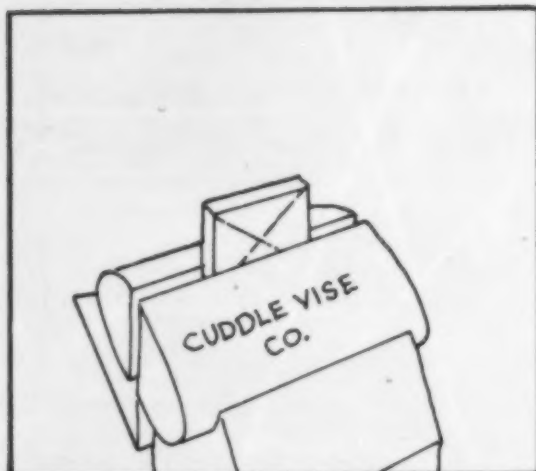
STEP 3 — Clamp the metal in a vise with the line. Allow $\frac{1}{2}$ inch clearance over the jaws of the vise.



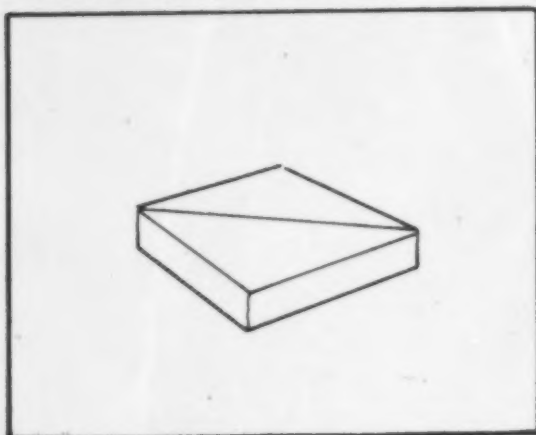
STEP 4 — Using a hacksaw, cut the metal with long even strokes.



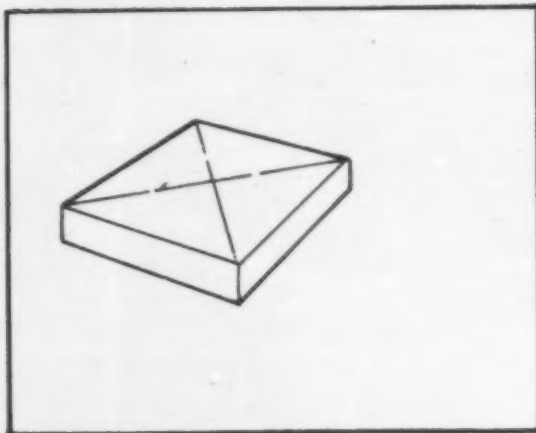
STEP 5 — Check the spacer to see if the corners are square.



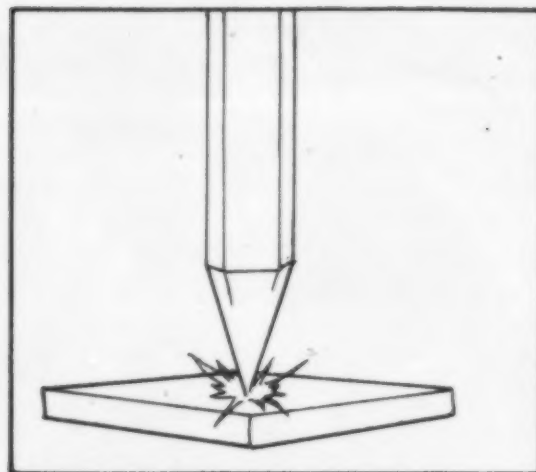
STEP 6 — Clamp the spacer in the vise with the cut end up, file the rough edge smooth.



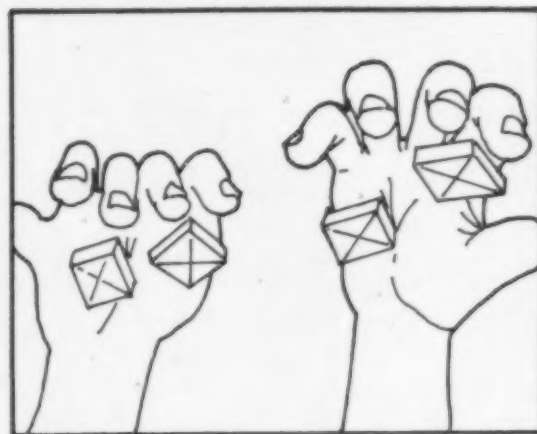
STEP 7 — Using the metal rule for a straight edge, place it diagonally across the spacer and scribe a line.



STEP 8 — Alternate the ruler and scribe another diagonal across the spacer. This will locate the center of the spacer.



STEP 9 — Center punch the point where the lines crossed.



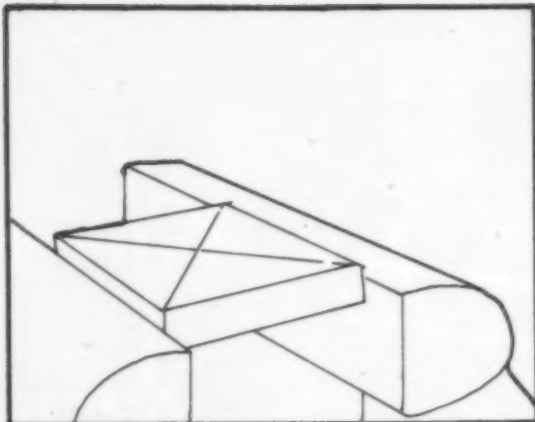
STEP 10 — Repeat steps 1 — 9 to form the other three spacers.

Check Point

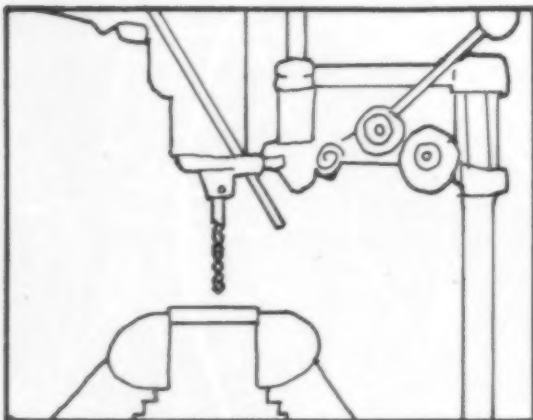
See that all burrs are removed and all spacers are uniform in size.

Instructional Objective **XXI**

Using the proper tools and equipment, each student will drill a 1/4 inch hole in all the spacers.



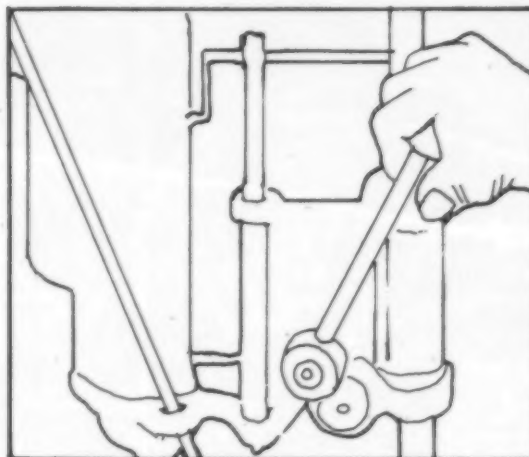
STEP 1 — Clamp one spacer in the vise on the drill press.



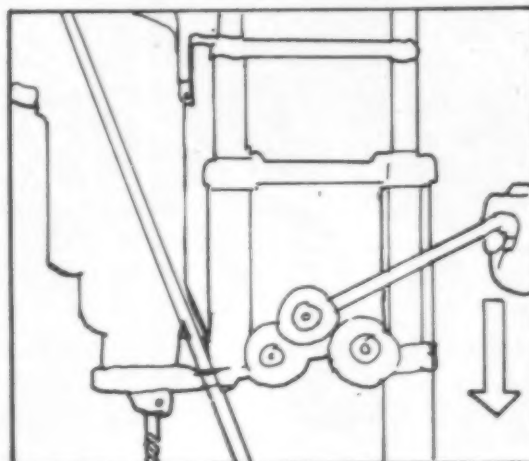
STEP 2 — Locate the vise so the drill bit is directly above the center of the spacer.



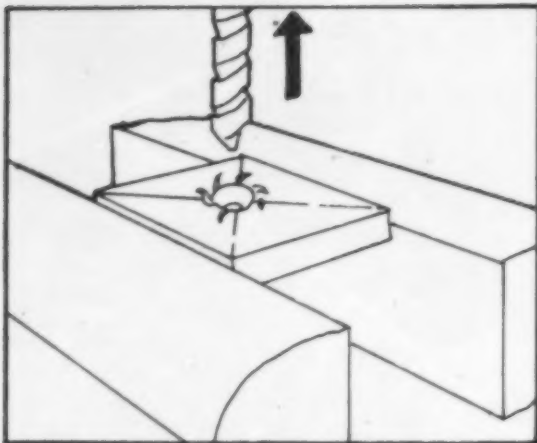
STEP 3 — Remember all safety rules which go along with the drill press. Review if needed.



STEP 4 — Grasp the handle of the drill press and turn on the drill.



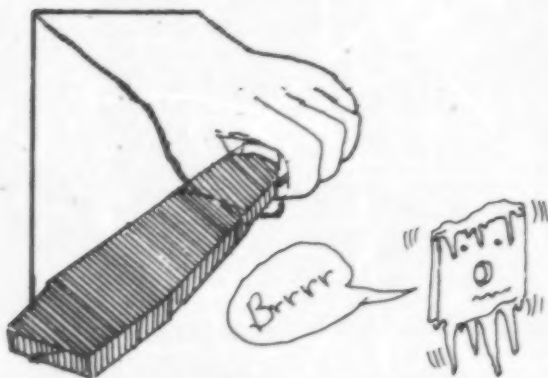
STEP 5 — Drill a hole through the metal by pulling down on the handle of the drill press.



STEP 6 — Let the drill handle up slowly and turn off the machine.



STEP 7 — Remove the spacer from the vise and repeat steps 1 — 6 on the other three spacers.



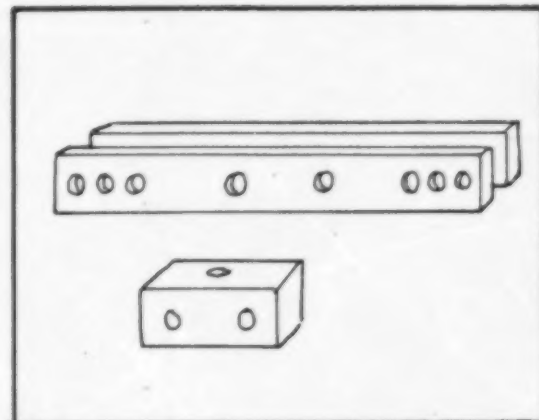
STEP 8 — Using a file, remove all burrs from the four spacers.

Check Point

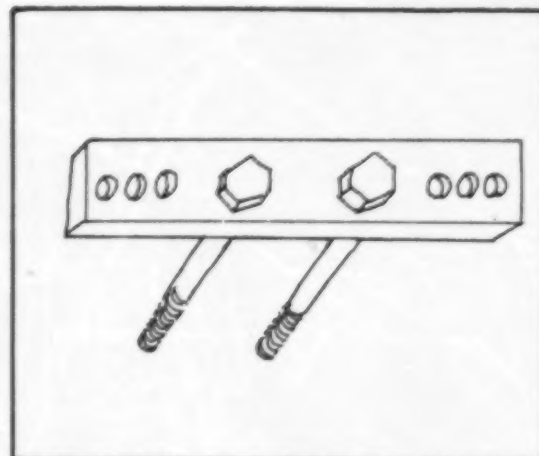
Are all holes in the center and are all the burrs removed?

Instructional Objective

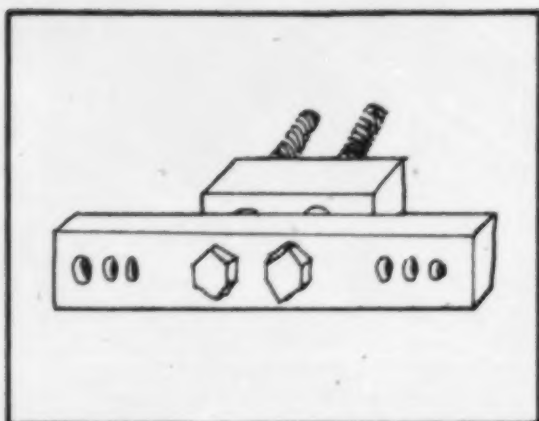
The student will assemble (put together) the gear puller.



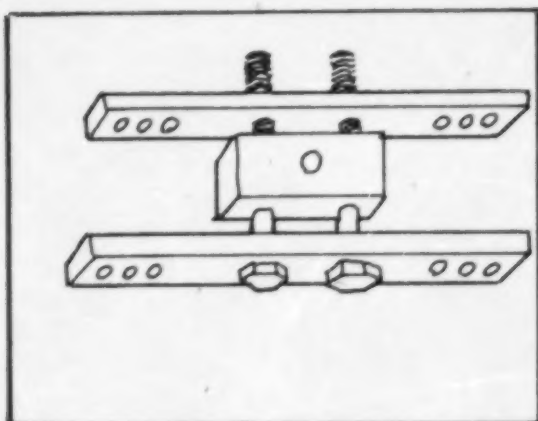
STEP 1 — Locate the two pieces of stock $6 \times \frac{3}{4} \times \frac{1}{4}$ inch and the center block ($1 \frac{5}{8} \times \frac{3}{4} \times \frac{3}{4}$ inch). Lay these three objects on the table as illustrated.



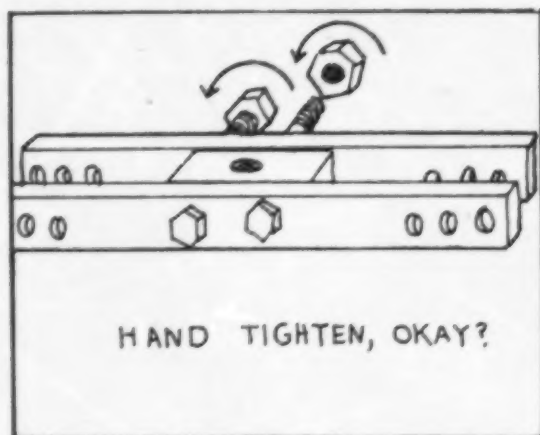
STEP 2 — Using one $6 \times \frac{3}{4} \times \frac{1}{4}$ inch piece, two $1\frac{1}{2} \times \frac{1}{4}$ inch bolts, slide the bolts through the two middle holes.



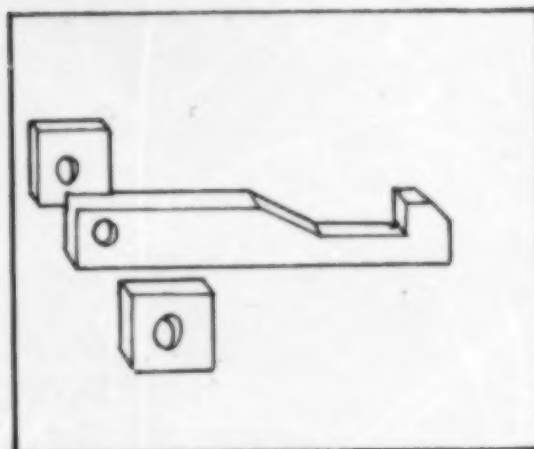
STEP 3 — Pick up the (1-5/8 x 3/4 x 1/4 inch) center block and slip the two bolts through the proper holes.



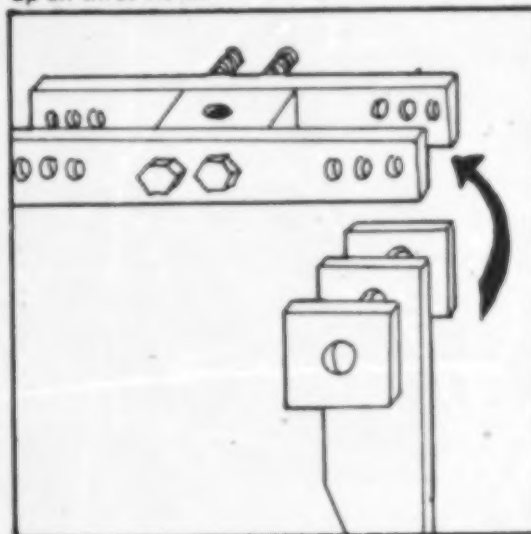
STEP 4 — Grasp the second 6 x 3/4 x 1/4 inch piece of metal and slide it on the two bolts.



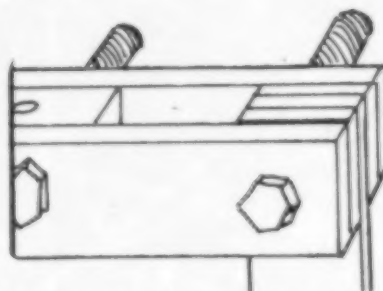
STEP 5 — Tighten two 1/4 inch nuts on each of the bolts.



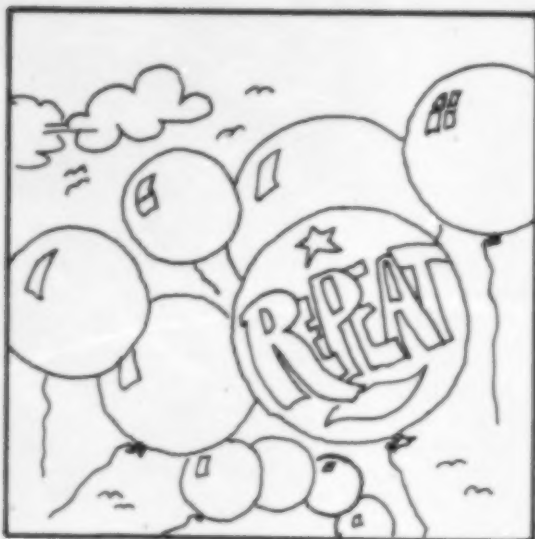
STEP 6 — Locate one hook and two spacers. Place a spacer on each side of the hook lining up all three holes.



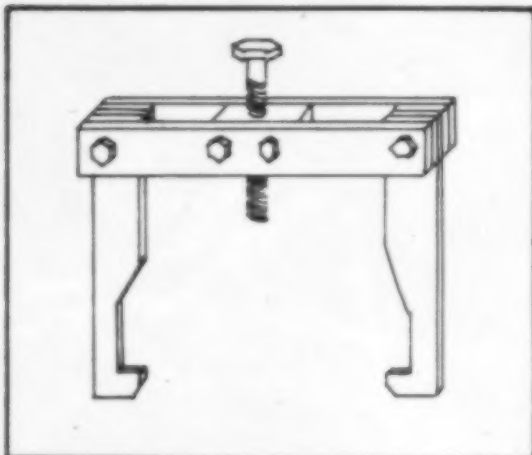
STEP 7 — Slide the spacers and the hook in between the two 6 x 3/4 x 1/4 inch pieces. Be sure the hook is toward the center block. Align the hook and spacer with the end hole of the 6 inch stock.



STEP 8 — Use a 1-1/2 x 1/4 inch bolt and slide it through the five pieces of metal. Tighten the nut finger tight on the bolt.



STEP 9 — Repeat steps 6 — 8 for the other hook and spacer.



STEP 10 — Pick up the $\frac{3}{8}$ inch bolt and screw it into the top of the center block ($1\frac{5}{4}$ x $\frac{3}{4}$ inch). The puller is now complete.

Check Point

Have your instructor inspect the gear puller for correct assembly.

OCCUPATIONAL DESCRIPTIONS

600.280-022 MACHINIST (mach. shop) machinist, all-around; machinist, first class; machinist, general; machinist, precision.

Sets up and operates machine tools, and fits and assembles parts to make or repair metal parts, mechanisms, tools, or machines, applying knowledge of mechanics, shop mathematics, metal properties, and layout and machining procedures: Studies specifications, such as blueprint, sketch, damaged part, or description of part to be replaced, to determine dimensions and tolerances of piece to be machined, sequence of operations, and tools, materials, and machines required. Measures, marks, and scribes dimensions and reference points to lay out stock for machining [LAY-OUT WORKER (mach. shop)]. Sets up and operates metal-removing machines, such as lathe, milling machine, shaper, or grinder, to machine parts to specifications. Verifies conformance to workpiece to specifications, using measuring instruments [TOOL-MACHINE SET-UP OPERATOR (mach. shop)]. Positions and secures workpiece in holding device, such as chuck or collet, or on surface plate or worktable with such devices as vises, V-blocks, and angle plates, and uses handtools, such as files, scrapers and wrenches, to fit and assemble parts to assemblies or mechanisms. Verifies dimensions and alignment with measuring instruments, such as micrometers, height gages, and gage blocks. May operate mechanism or machine, observe operation, or test with inspection equipment, to diagnose malfunction of machine or to test repaired machine. May perform flame cutting and arc or gas welding operations, when required. May develop specifications from general description and draw or sketch product to be made.

600.280-042 MAINTENANCE MACHINIST (any ind.) machine repairer; shop mechanic; machinist.

Sets up and operates variety of machine tools, and fits and assembles parts to fabricate or repair machine tools and maintain industrial machines, applying knowledge of mechanics, shop mathematics, metal

properties, layout, and machining procedures: Observes and listens to operating machines or equipment to diagnose malfunction and determine need for adjustment or repair. Studies blueprint, sketch, machine part, or specifications to determine type and dimensions and reference points on metal stock surfaces, using such measuring and marking devices as calibrated ruler, micrometer, caliper, and scribe [LAY-OUT WORKER (mach. shop)]. Dismantles machine or equipment, using handtools, such as wrench and screwdriver, to examine parts for defect or to remove defective part. Substitutes new part or repairs or reproduces part from various kinds of metal stock, using handtools, such as scraper, file, and drill, and machine tools, such as lathe, milling machine, shaper, borer, and grinder [MACHINIST (mach. shop)]. Assembles and starts machine to verify correction of malfunction. Maintains and lubricates machine tools and equipment, using handtools, ladder, and lubricants. May weld broken structural parts, using arc or gas welding equipment. May repair or replace faulty wiring, switches, or relays. May be designated according to type of equipment repaired as MACHINIST, CONSTRUCTION EQUIPMENT (any ind.).

601.280-054 TOOL-MACHINE SET-UP OPERATOR (mach. shop) machine-tool operator, general; machinist; set-up-operator, tool.

Sets up and operates variety of machine tools, such as radial drill press, lathes, milling machines, shapers, and grinders, to machine metal workpieces, such as patterns and machine, tool, or die parts, usually on custom basis, analyzing specifications, and determining tooling by applying knowledge of metal properties, machining, and shop mathematics: Studies blueprint or layout on workpiece to visualize machining required, and plans sequence of operations. Selects method of holding workpiece. Lifts workpiece manually or using hoist, and positions and secures it to holding device, such as machine table, chuck, centers, or fixture, using wrenches and aids, such as shims, parallel blocks, planer gages and clamps. Verifies workpiece position, using

instruments, such as *surface gages*, height gages, and *dial indicator*. Selects feed rate, cutting speed, depth of cut, and cutting tool (bar tool, rotary cutter, or abrasive wheel) for each operation, according to knowledge of metal properties, machining, and shop mathematics. Positions and secures tool in toolholder (chuck, collet, or toolpost). Moves controls to position tool and workpiece in relation to each other, and to set feeds, speeds, and depth of cut. Starts machine, turns handwheel to feed tool in workpiece or vice versa, and engages automatic feeding device. Turns valve handle to start flow of *coolant* against tool and workpiece. Observes operation and regulates tool position and action. Verifies conformance of machined workpiece to specifications, using instruments, such as micrometers, gages, and *gage blocks*. May measure, mark, and scribe workpiece to lay out for machining [LAY-OUT WORKER (mach. shop)]. May devise ways of clamping workpieces and make special *jigs* and *fixtures* as needed. May work on nonmetallic materials. May operate bench grinder or cutter grinding machine to sharpen tools [TOOL-GRINDER OPERATOR (mach. shop)].

608.685-018 PRODUCTION-MACHINE TENDER (mach. shop) all-around-machine operator; machine hand; machine operator, general; production-machine operator; machinist; miscellaneous-machine operator.

Tends any of variety of machine tools, such as lathes, drill presses, milling machines, grinders, or special-purpose machines to machine metal workpieces to specifications on production basis. Lifts workpiece manually or with hoist and positions and secures in *fixture*, or loads automatic feeding device. Starts machine, engages feed, and observes operation. Verifies conformance of machined workpieces to specifications, using instruments, such as preset comparator, fixed gages, calipers, or micrometer. May move controls to adjust machine. Changes worn cutting tools, using wrenches. May operate *bench grinder* to sharpen tools. May machine plastics or other nonmetals. May tend machines and equipment other than machine tools, such as welders. May be required to transfer from one type of machine to another as situation demands. May be required to have experience with particular material, product, or size, type, or trade name of machine and be designated accordingly.